DINAMAP* *XL*

Vital Signs Monitor

Service Manual

Johnson & Johnson
MEDICAL INC.

*TRADEMARK

LIST OF EFFECTIVE PAGES

Part No./Rev.	Page No.	Date of Latest Revision
776639A	All	Original (April 1995)
776639B	All	Revised (April 1996)

U.S. Patent 4,349,034
U.S. Patent 4,360,029
U.S. Patent 4,501,280
U.S. Patent 4,543,962
U.S. Patent 4,546,775
Patent Pending

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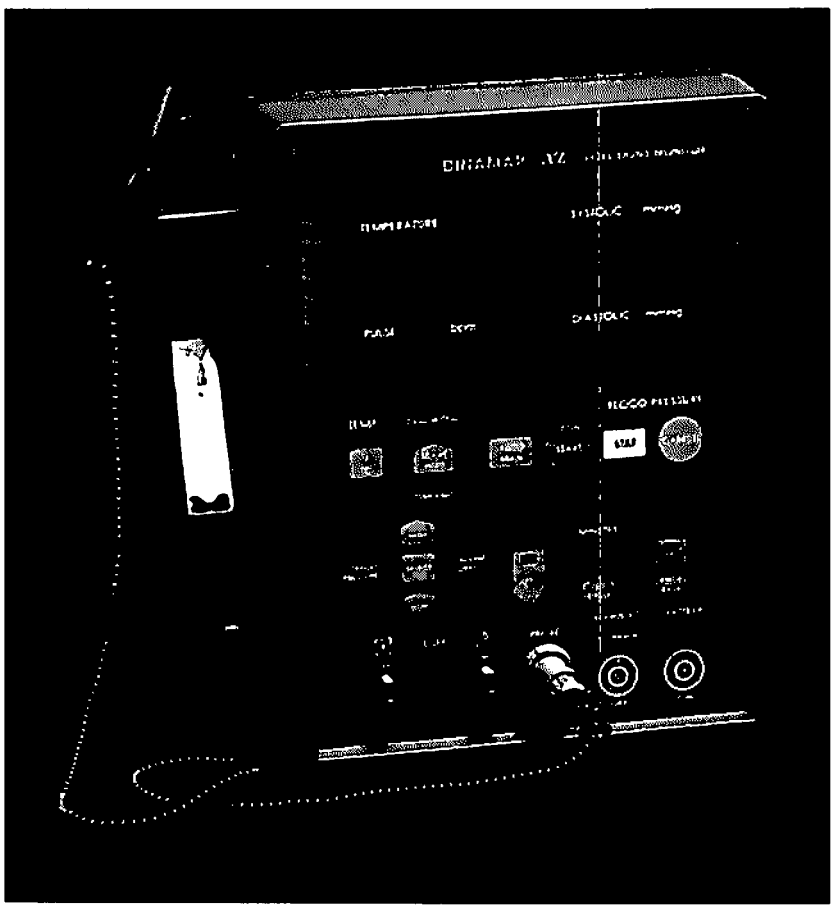


DINAMAP *XL* Vital Signs Monitor

SECTION 1. INTRODUCTION

1.1 SCOPE OF MANUAL

This Service Manual provides service and parts repair information for DINAMAP *XL* Vital Signs Monitors, including Monitor Models 9300 and 9340 and their international variations. This manual is intended for use by trained service technicians who are familiar with electromechanical devices and digital and analog circuit techniques.

WARNING

To reduce the risk of electric shock, do not remove cover or back. Refer servicing to qualified service personnel.

All unit repairs should be performed only by trained service technicians.

Voltages dangerous to life exist in this unit. Take care when servicing power supply and display assembly.

For information about operating the Monitor in a clinical environment, refer to:

DINAMAP *XL* Vital Signs Monitor Operation Manual 776-600

The first part of this Service Manual consists of three sections that provide general service information about the Monitor:

- Section 1 describes this volume and tells you how to use it. Information is also provided about physical and functional characteristics of the Monitor, and how to get assistance in the event the unit fails to function properly.
- Section 2 provides system principles of operation including functional descriptions.
- Section 3 provides information about general maintenance and troubleshooting of the Monitor.

The rest of this manual is divided into sections that provide detailed principles of operation, component information, and service diagrams about each of the subassemblies, modules, and circuit PWAs of the Monitor. At the time of publication, these sections consisted of the following:

Section 4	Top Assembly 354-456
Section 5	Top Assembly 354-464
Section 6	Bezel Assembly 332-213
Section 7	Bezel Assembly 332-220
Section 8	Display PWA 315-438
Section 9	Display PWA 315-439
Section 10	CPU PWA 315-437
Section 11	Power Supply PWA 315-372
Section 12	Transformer Assy 320-432
Section 13	Transformer Assy 320-433
Section 14	AC Power Conn Assy 320-431
Section 15	Pneumatics PWA 315-317
Section 16	Pneumatics PWA 315-480

1.2 MANUAL CHANGES

If, in the normal use of this manual, you notice errors, omissions, or incorrect data, or if you can suggest comments that may help improve this manual, please complete the Publications Change Request form in the back of this manual. Submit the form to:

Johnson & Johnson Medical, Inc.
Technical Publications
P.O. Box 31800
4110 George Road
Tampa, Florida 33631-3800

Changes to the Service Manual, either in response to user input or to reflect continuing product improvements, are accomplished through reissue.

Changes occurring between reissues are addressed through Change Information Sheets and replacement pages. If a Change Information Sheet does not accompany your manual, the manual is correct as printed.

1.3 SERVICE POLICY

The warranty for this product is enclosed with the product in the shipper carton. All repairs on products under warranty must be performed or approved by Customer Service personnel. *Unauthorized repairs will void the warranty.* Products not covered by warranty should be repaired only by qualified electronics service personnel.

1.3.1 Extended Warranties

Extended warranties may be purchased on most products. Contact your Sales Representative for details and pricing.

1.3.2 Assistance

If the product fails to function properly, or if assistance, service or spare parts are required, contact Customer Support. Before contacting Customer Support, it is helpful to attempt to duplicate the problem and to check all accessories to ensure that they are not the cause of the problem. If you are unable to resolve the problem after checking these items, contact J & J Medical. Prior to calling, please be prepared to provide

- ☐ product name and model number
- ☐ a complete description of the problem

If the repair parts or service are necessary, you will also be asked to provide

- ☐ the product serial number
- ☐ the facility's complete name and address
- ☐ a purchase order number if the product is to be repaired or you order spare parts
- ☐ the facility's J & J Medical account number, if possible
- ☐ the 6-digit part number for spare or replacement parts

1.3.3 Service

If your product requires warranty, extended warranty or non-warranty repair service, call Customer Support and a representative will assist you. Estimates for non-warranty repairs are provided at no charge; however, the product must be sent to the J & J Medical Service Center in order to provide you with an estimate.

To facilitate prompt service in cases where the product has external chassis or case damage, please advise the Customer Support representative when you call.

The Customer Support representative will record all necessary information and will provide you with a Return Authorization Number. Prior to returning any product for repair, you must have a Return Authorization number. Call J & J Medical at

1-800-237-2033

and select Parts, Product Service, and Customer Support Monday through Friday, 8:00 a.m. to 6:00 p.m. EST, excluding holidays.

Packing Instructions
Follow these recommended packing instructions.

- ☐ Remove all hoses, cables, sensors, power cords and ancillary products such as printers and external battery packs from the monitor before packing.
- ☐ Pack only the accessories you are requested to return; place them in a separate bag and insert the bag and the product inside the shipping carton.
- ☐ Use the original shipping carton and packing materials, if available.

If the original shipping carton is not available

- ☐ Place the product in a plastic bag and tie or tape the bag to prevent loose particles or materials from entering openings such as hose ports.
- ☐ Use a sturdy corrugated container to ship the product; tape securely to seal the container for shipping.
- ☐ Pack with 4 to 6 in. of padding on all sides of the product.

Insurance
Insurance is at the customer's discretion. Claims for damage to the product must be initiated by the shipper.

1.3.4 Service Loaners

A loaner unit is provided at no charge during the service life of the product when the repair service is performed by J & J Medical. Within 48 hours of your request, a loaner will be shipped to your facility.

- ☐ J & J Medical, Inc. will pay shipping charges for a loaner sent to the customer for product repairs under the warranty.
- ☐ Shipping charges for a loaner sent to the customer for product repairs not under warranty will be billed to the customer.
- ☐ Shipping charges for the return of a loaner to J & J Medical, Inc. will be paid by the customer.

All loaners provided to customers must be returned within the specified time stated on the loaner agreement or a rental fee will be incurred.

1.3.5 Repair Parts

Repair parts can be ordered via phone to Customer Support or via FAX. Exchange replacement assemblies such as Circuit Board Assemblies also are available; ask the Customer Support representative for details.

Via FAX ---- 1-813-887-2892 or -2893

Please allow one working day for confirmation of your order. All orders must include the following information.

- ☐ Facility's complete name, address, and phone number
- ☐ FAX number
- ☐ Your purchase order number
- ☐ Your J & J Medical account number

1.3.6 Replacement Accessories

Replacements such as hoses, sensors, etc. must be purchased from Johnson & Johnson Health Care Systems at 1-800-255-2500. Please have the 4-digit Reorder/Product Code of the item you wish to order, your purchase order and account number available.

1.4 PRODUCT DESCRIPTION

The DINAMAP *XL* Monitor is a portable device used for noninvasive monitoring of patients and automatic measurement of systolic and diastolic pressure, mean arterial blood pressure (MAP), and pulse rate for neonatal or adult/pediatric patients. The monitors are portable and battery operated and are primarily intended for use in hospital acute care settings such as Same Day Surgery, Emergency, PACU, Progressive Care, Labor and Delivery, GI/Endoscopy, and Medical/Surgery Units.

1.4.1 General Description

The units described in this manual are available in two basic Monitor models: the Model 9300 Monitor features measurement of noninvasive blood pressure (NIBP); the Model 9340 Monitor adds temperature measurement features. Within each model group, there are international versions that add a unique digit to the group product code, such as the code 9302 version of the Model 9300 Monitor for Germany. Refer to paragraph 1.4.5 for a complete description of DINAMAP *XL* Monitor product codes.

The unit operates from AC power using a standard, hospital-grade power cord, or from a battery.

1.4.2 Physical Description

Each Monitor includes an accessory kit and the monitor unit itself. The top assembly is comprised of a sub-top assembly and mounting hardware. When the top assembly is removed, the sub-top assembly is exposed.

The sub-top assembly is identified by unique code for each Model and consists of the bezel, pump, power supply and pneumatics PWAs, transformer, AC power connector, muffler, and battery. When the bezel is removed, the system processor and display PWAs are exposed.

1.4.3 Controls and Indicators

Maintenance controls and indicators for the Model 9300 Monitor are shown in Figure 1-1 and listed in Table 1-1. Rear panel controls and indicators are shown in Figure 1-2 and listed in Table 1-2. Refer to the Operation Manual for a description of Monitor operation in a clinical environment.

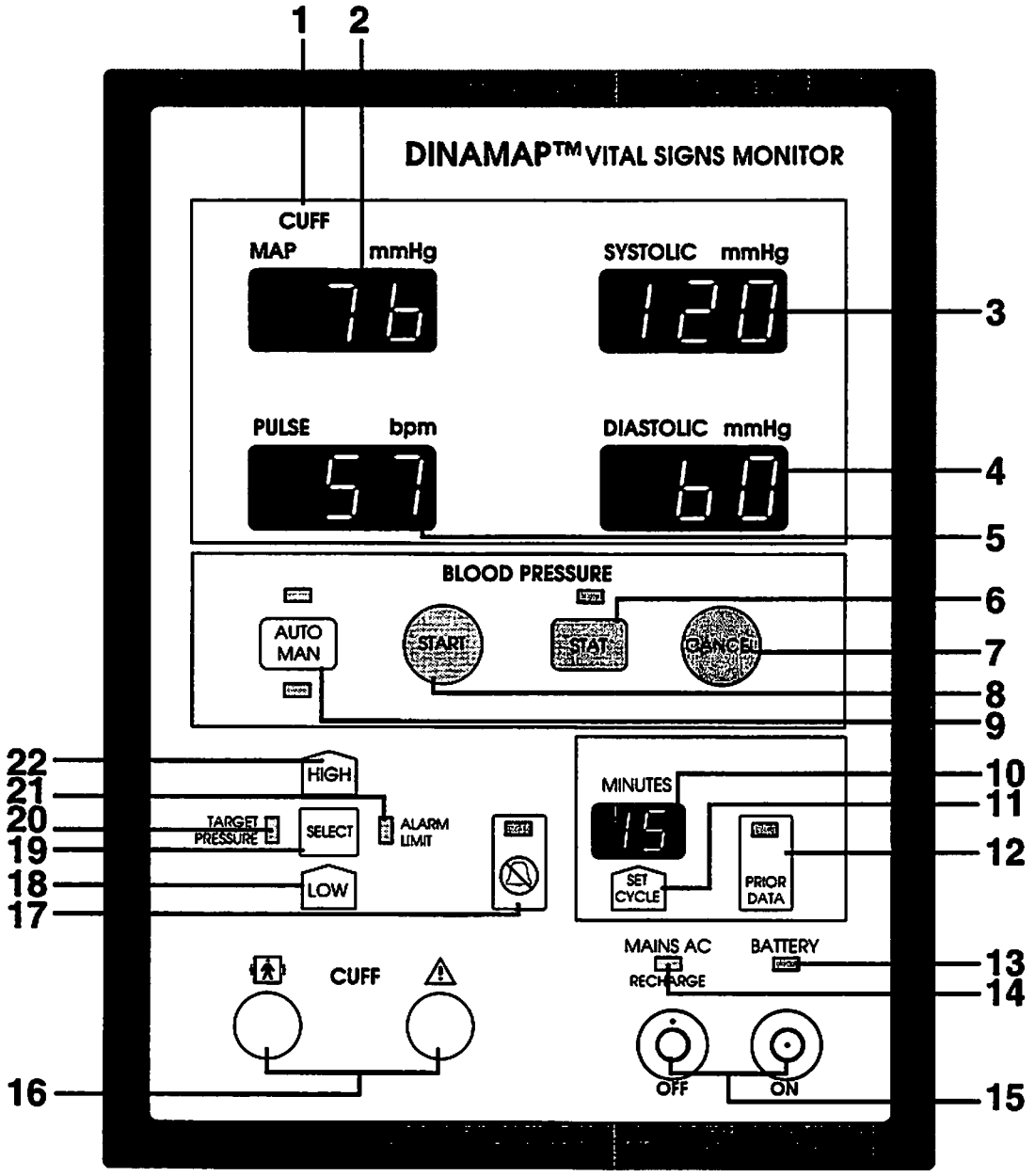


Figure 1-1. Model 9300 Monitor Maintenance Controls and Indicators

Table 1-1. Model 9300 Monitor Maintenance Controls And Indicators

ITEM	NAME	FUNCTION
1	CUFF	Normally used to indicate cuff pressure but not used for maintenance tests
2	MAP mmHg	Displays voltages and offsets during various maintenance modes
3	SYSTOLIC mmHg	Displays voltages, offsets, and signal levels during various maintenance modes
4	DIASTOLIC mmHg	Displays offsets and signal levels during various maintenance modes
5	PULSE bpm	Displays software revisions, voltages, and offsets during various maintenance modes
6	STAT	Normally used to select the NIBP stat mode, but not used for maintenance tests
7	CANCEL	Cancels maintenance tests
8	START	Normally used to start a determination, but not used for maintenance tests
9	AUTO/ MANUAL	Normally used to change operating mode from AUTO to MANUAL or MANUAL to AUTO, but not used for maintenance tests
10	MINUTES	Flashes 88 during maintenance testing
11	SET CYCLE	Holding this switch in for 4 seconds while pressing ON starts maintenance calibration mode for 3 minutes (indefinitely if held for 20 seconds) While in calibration mode, pressing SET CYCLE increments through Modes 1-5

Table 1-1. Model 9300 Monitor Maintenance Controls And Indicators (Continued)

ITEM	NAME	FUNCTION
12	PRIOR DATA	Normally displays data from a previous determination and elapsed time, but not used for maintenance tests
13	BATTERY	Lit when monitor is powered from the battery and blinks during display test mode
14	MAINS AC RECHARGE	Indicates AC line power is present and battery is being charged.
15	ON - OFF	Controls power to the monitor.
16	CUFF	Pneumatic hose connection.
17		Normally used to mute or enable audio alarm, but not used for maintenance tests
18	LOW	Selects different states in Calibration mode 5; in calibration mode 2, selects adult mode with full or half gain and neonate mode with full or half gain
19	SELECT	Normally selects high and low alarm limits, but not used for maintenance tests
20	TARGET PRESSURE	Normally used to indicate target pressure setting mode but not used for maintenance tests
21	ALARM LIMIT	Normally used to indicate alarm limit setting mode but not used for maintenance tests
22	HIGH	Selects different states in Calibration mode 5; in calibration mode 2, selects adult mode with full or half gain and neonate mode with full or half gain

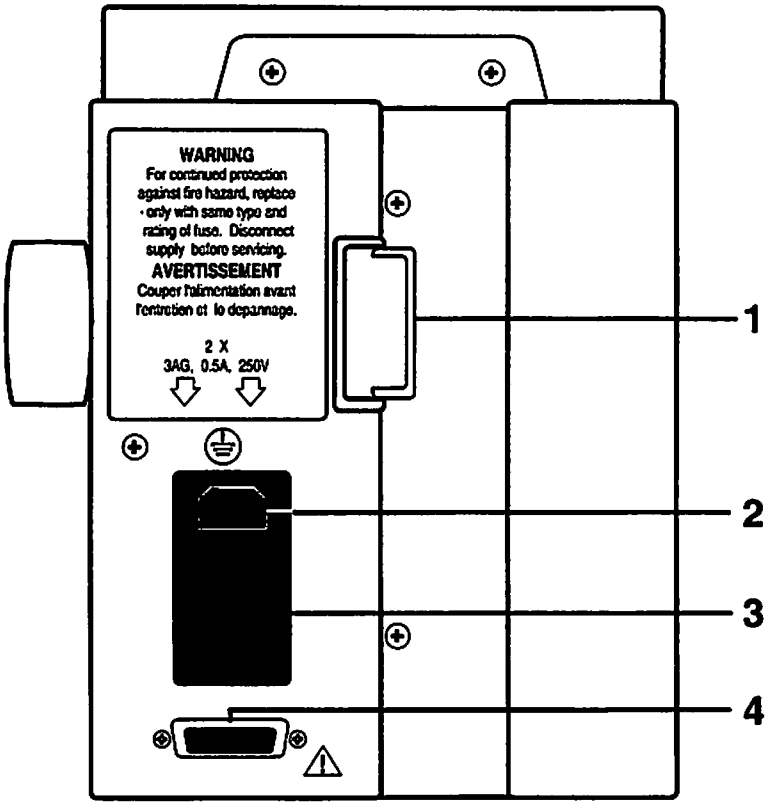


Figure 1-2. Rear Panel Controls and Indicators

Table 1-2. Rear Panel Controls and Indicators

ITEM	NAME	FUNCTION
1	POLE CLAMP	Clamps monitor securely to pole.
2	LINE POWER CONN.	AC power cord connector.
3	AC LINE FUSES	Contained under latched fuse compartment door.
4	DATA INTERFACE CONN.	Port for connection of external computer. **NOTE:** Refer to Section 2 of this manual and to DINAMAP Vital Signs Monitors Host Communications Reference Manual 776-632 for information on how to use this port.

Maintenance controls and indicators for the Model 9340 Monitor are shown in Figure 1-3 and listed in Table 1-3. The description of rear panel controls and indicators is the same as for the Model 9300 Monitor.

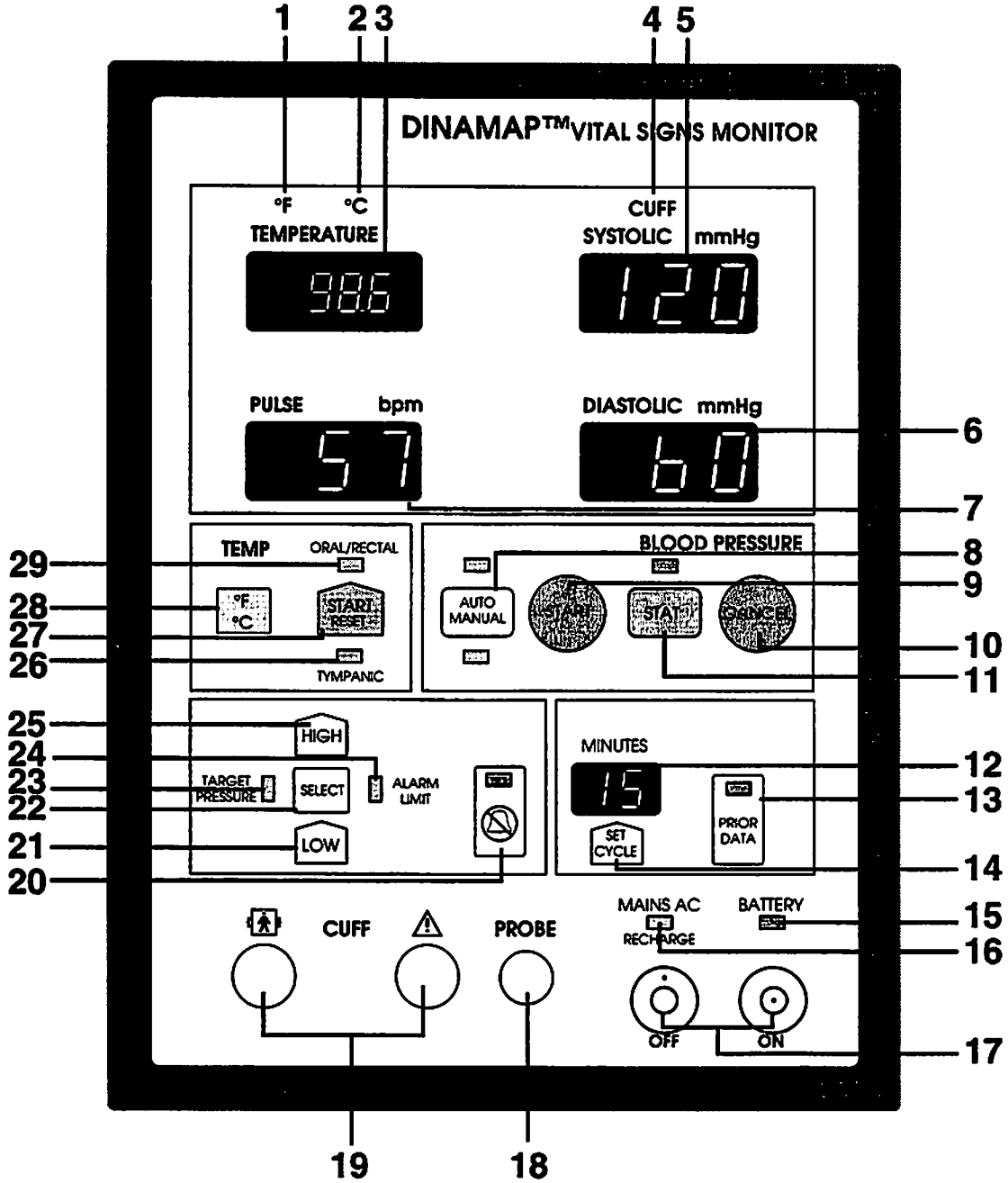


Figure 1-3. Model 9340 Monitor Maintenance Controls and Indicators

Table 1-3. Model 9340 Monitor Maintenance Controls and Indicators

ITEM	NAME	FUNCTION
1	°F	Normally used to indicate Fahrenheit temperature mode but not used for maintenance tests
2	°C	Normally used to indicate centigrade temperature mode but not used for maintenance tests
3	TEMPER-ATURE	Displays voltages and offsets during various maintenance modes
4	CUFF	Normally used to indicate cuff pressure but not used for maintenance tests
5	SYSTOLIC mmHg	Displays voltages, offsets, and signal levels during various maintenance modes
6	DIASTOLIC mmHg	Displays offsets and signal levels during various maintenance modes
7	PULSE bpm	Displays software revisions, voltages, and offsets during various maintenance modes
8	AUTO/ MANUAL	Normally used to change operating mode from AUTO to MANUAL or MANUAL to AUTO, but not used for maintenance tests
9	START	Normally used to start a blood pressure determination, but not used for maintenance tests.
10	CANCEL	Cancels maintenance tests
11	STAT	Normally used to select NIBP stat mode, but not used for maintenance tests
12	MINUTES	Flashes 88 during maintenance testing, except in Cal Mode 5 shows 3 or 12 for 3- or 12-minute predictive temperature mode selection
13	PRIOR DATA	Normally displays data from a previous determination and elapsed time, but not used for maintenance tests

Table 1-3. Model 9340 Monitor Maintenance Controls and Indicators (Continued)

ITEM	NAME	FUNCTION
14	SET CYCLE	Holding this switch in for 4 seconds while pressing ON starts maintenance calibration mode for 3 minutes (indefinitely if held for 20 seconds) While in calibration mode, pressing SET CYCLE increments through Modes 1-5
15	BATTERY	Lit when monitor is powered from the battery and blinks during display test mode
16	MAINS AC RECHARGE	Indicates AC line power is present and battery is being charged
17	ON - OFF	Controls power to the Monitor
18	PROBE	Probe connection
19	CUFF	Pneumatic hose connection
20		Normally used to mute or enable audio alarm, but not used for maintenance tests
21	LOW	Selects different states in Calibration mode 5; in calibration mode 2, selects adult mode with full or half gain and neonate mode with full or half gain
22	SELECT	Normally selects high and low alarm limits, but not used for maintenance tests
23	TARGET PRESSURE	Normally used to indicate target pressure setting mode but not used for maintenance tests
24	ALARM LIMIT	Normally used to indicate alarm limit setting mode but not used for maintenance tests
25	HIGH	Selects different states in Calibration mode 5; in calibration mode 2, selects adult mode with full or half gain and neonate mode with full or half gain
26	TYMPANIC	Lights when tympanic (IR) probe is connected

Table 1-3. Model 9340 Monitor Maintenance Controls and Indicators (Continued)

ITEM	NAME	FUNCTION
27	START RESET	Normally used to start or stop a temperature determination or clear an error, but not used for maintenance testing
28	°F °C	Selects either Fahrenheit or centigrade units for temperature display
29	ORAL/ RECTAL	Lights when either thermistor probe (oral or rectal) is connected

1.4.4 Storage Battery

The storage battery specified for use with the DINAMAP *XL* Monitor is a sealed lead-acid battery. It was selected for its high capacity (2.7 Ampere-hours), quick-charge ability (recharge time as little as one hour) and ease of replacement.

The expected battery life cycle is largely dependent on the way the battery is used. If the battery is allowed to fully discharge after each use and then is fully recharged soon after use, the battery should last for the full two hundred recharge cycles. If a battery is used in the top one third of its charge and fully charged whenever possible, up to twelve hundred cycles can be expected, approximately six times the number of cycles used to 100% capacity.

A battery that has been fully discharged can be fully charged by the Monitor in less than four hours. If a storage battery is installed while the Monitor is connected to an external AC power source (even if the Monitor is off) the monitor will attempt to charge the battery.

A fully charged battery can be stored up to six months and retain as much as 80% of its capacity. One fully charged battery will supply enough energy to operate the Monitor for approximately 6 hours. This operation would include temperature and non-invasive blood pressure determinations at five minute intervals.

1.4.5 Product Reorder Information

The Monitor has been designed to operate from various AC power sources from many countries. The product reorder codes are listed in Table 1-4.

Table 1-4. Product Reorder Numbers

Model	Country	Product Reorder Code		
		NIBP Only	Pred. Temp	IR Temp.
9300	Domestic, 120 Vac, 60 Hz	9300		9350
9301	British, 230 Vac, 50 Hz	9301		9351
9302	German, 220 Vac, 50 Hz	9302		
9303	French, 220 Vac, 50 Hz	9303		
9340	Domestic, 120 Vac, 60 Hz		9320	
9341	British, 230 Vac, 50 Hz		9321	

All models listed above are also supplied with a power cable, adult DURA-CUF* blood pressure cuff, 12-foot air hose, and operation manual. The Model 934x series Monitors are also supplied with a mobile pole and base and an accessory basket for holding cuffs and hoses.

*TRADEMARK

1.4.6 Accessory Reorder Numbers

Table 1-5 lists the accessories that have been designated for use with the Monitor and are identified by reorder number and part number where applicable. This list contains most of the accessories available. For a complete list of accessories, refer to the DINAMAP *XL* Vital Signs Monitor Operation Manual 776-600.

Table 1-5. Accessories

	PRODUCT DESCRIPTION	SALES DEPT. REORDER NO.	SERV. DEPT. PART N0.
§	DINAMAP *XL* Vital Signs Monitor Operation Manual 776-600	NA	776-600
§	DURA-CUF Bladderless Blood Press. Cuff, Adult	2774	n/a
	DURA-CUF Bladderless Blood Press. Cuff, Sm. Adult	2779	n/a
	DURA-CUF Bladderless Blood Press. Cuff, Child	2781	n/a
	DURA-CUF Bladderless Blood Press. Cuff, Infant	2783	n/a
	DURA-CUF Bladderless Blood Press. Cuff, Lg. Adult	2791	n/a
	DURA-CUF Bladderless Blood Pressure Cuff, Thigh	2796	n/a
§	Hose Assembly, 12 foot	8841	n/a
	Hose Assembly, 24 foot	8842	n/a
	Hose Assembly, 8 foot (neonatal)	8840	n/a
	CRITIKON* Disp. Blood Press. Cuff, Neo. #1 (sterile)	8311(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #2 (sterile)	8312(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #3 (sterile)	8313(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #4 (sterile)	8314(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #1 (non-sterile)	2638(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #2 (non-sterile)	2633(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #3 (non-sterile)	2628(10/case)	n/a

§Indicates that one of each of these items is shipped with all Monitors.

*TRADEMARK

Table 1-5. Accessories (Continued)

	PRODUCT DESCRIPTION	SALES DEPT. REORDER NO.	SERV. DEPT. PART NO.
	CRITIKON Disp. Blood Press. Cuff, Neo. #4 (non-sterile)	2623(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Neo. #5 (non-sterile)	2619(10/case)	n/a
	CRITIKON Disp. Blood Press. Cuff, Lg. Adult (non-sterile)	2643	n/a
	CRITIKON Disp. Blood Press. Cuff, Adult (non-sterile)	2603	n/a
	CRITIKON Disp. Blood Press. Cuff, Sm. Adult (non-sterile)	2608	n/a
	CRITIKON Disp. Blood Press. Cuff, Thigh (non-sterile)	2648	n/a
	CRITIKON Disp. Blood Press. Cuff, Child (non-sterile)	2613	n/a
	CRITIKON Disp. Blood Press. Cuff, Infant (non-sterile)	2618	n/a
	CRITIKON Disp. Blood Press. Cuff,Lg. Adult (infect. ctl.)	2642	n/a
	CRITIKON Disp. Blood Press. Cuff,Adult (infect. ctl.)	2602	n/a
	CRITIKON Disp. Blood Press. Cuff,Sm. Adult (infect. ctl.)	2607	n/a
	CRITIKON *Soft* Neonatal Blood Pressure Cuffs:		
	Neonatal #1, 3 cm-6 cm	2521	
	Neonatal #2, 4 cm-8 cm	2422	
	Neonatal #3, 6 cm-11 cm	2523	
	Neonatal #4, 7 cm-13 cm	2524	
	Neonatal #5, 8 cm-15 cm	2525	
	CRITIKON *Soft* Adult/Pediatric Blood Pressure Cuffs:		
	Infant	2500	
	Child	2501	
	Small Adult	2502	
	Adult	2503	
	Large Adult	2504	
	Thigh	2505	

Table 1-5. Accessories (Continued)

	PRODUCT DESCRIPTION	SALES DEPT. REORDER NO.	SERV. DEPT. PART N0.
	Calibration Kit	8886	320-246
§	Power Cord, Domestic	8884	316-159
§	Power Cord, International	8885	320-193
	Model 902 Mobile Stand	0902	n/a
†¥	DINAMAP BP Accessory Pole	3207	n/a
†¥	DINAMAP BP Accessory Base	3208	n/a
†¥	DINAMAP BP Accessory Basket with Tray	3209	n/a
§	Writing Tablet Holder	8812	n/a
§	Writing Tablets (5)	8811(25/case)	n/a
†	Predictive Temperature Probe Kit	8977	n/a
†	Temperature Probe covers (100)	8815(5000/case)	n/a
	Probe Cover Disposal Bag	8816(200/case)	n/a
	Temperature Calibration Plug	n/a	320-635
	White Plastic Cuff Adapters (Child & Sm. Adult)	n/a	754-135
¥	Infrared (IR) Temperature Probe Kit	140X	n/a
¥	Tympanic Probe Covers	8818(21 ea.)	n/a
¥	Tympanic Probe Covers	8818(1050/case)	n/a
	RS232 Interface Adapter Kit	8801	n/a
	Male locking luer conn., plastic for MRI environ.	300665(10/pkg.)	n/a
	Female locking luer conn., plastic for MRI environ.	300668(10/pkg.)	n/a

† Indicates that one of each of these items is shipped with the Model 9340 Monitor with 932x product code.
¥ Indicates that one of each of these items is shipped with the Model 9340 Monitor with 935x product code.

1.4.7 Specifications

The Monitor has been designed and manufactured to meet the requirements of the following specifications:

CSA Standard C22.2, No. 125-1984, Electromedical Equipment (Domestic Units)

UL 544 Standards for Safety, Medical and Dental Equipment 7/91 (USA)

C22.2 No. 125 Medical Electrical Equipment, Part 1 General Requirements for Safety. (Canada)

IEC 601-1 Medical electrical equipment Part 1: General requirements for safety (1988)

IEC 601-1 Amendment 1, 1991, (UK, France, Germany, Scandinavia)

NF C 74-380, 2/85,9/86,3/93, Electromedical & Monitoring Equipment, Safety requirements (France)

1.4.7.1 Mechanical Specifications

The mechanical specifications for the Monitor are listed in Table 1-6.

1.4.7.2 Environmental Specifications

The environmental specifications for the Monitor are listed in Table 1-7.

1.4.7.3 Electrical Specifications

The electrical specifications for the Monitor are listed in Table 1-8.

1.4.7.4 Performance Specifications

The performance specifications for the Monitor are listed in Table 1-9.

Table 1-6. Mechanical Specifications

ITEM	SPECIFICATION
SIZE	9.1 inches high; 7.9 inches wide (excluding knob); 6.9 inches deep.
WEIGHT	9.6 pounds, approximately.
COLOR	Monitor - blue case with multi-color front panel. Oral Probe - blue; Rectal Probe - red.
MOUNTINGS	Horizontal Surface; four rubber feet. Pole Mount; Integral pole mount and clamp accepts 3/8 inch to 1-1/4 inch diameter pole.
PORTABILITY	The Monitor can be hand carried by the Tablet Holder or recessed handle. When attached to the 3207/3208 Stand, the Monitor and accessories can be wheeled from patient to patient.
BATTERY ACCESSIBILITY	Battery is accessible when the back panel is removed
POWER CABLE DOMESTIC	10 foot, detachable, blue jacketed 16 gauge terminated with a three-prong hospital grade plug.
POWER CABLE INTERNATIONAL	10 foot, detachable, blue jacketed, 16 gauge unterminated.

Table 1-7. Environmental Specifications

ITEM	SPECIFICATION
OPERATING TEMPERATURE	+10° C to +40° C (+50° F to +104° F)† +15.5° C to +40° C (+60° F to +104° F)‡
STORAGE TEMPERATURE	-34° C to +75° C (-29° F to +167° F)† 20° C to +50° C (-4° F to +122° F)‡-
HUMIDITY RANGE	0% to 95%, non-condensing.
ALTITUDE	-1000 to +15,000 feet.
	BF SYMBOL: This symbol indicates the classification of this type of equipment is in compliance with IEC Publication 601-1 and BS5724-1, Type BF.
	ATTENTION: Consult accompanying documents.

†All models except Model 9340 Monitor with thermometer.
‡Model 9340 Monitor with thermometer only.

Table 1-8. Electrical Specifications

ITEM	SPECIFICATION
INPUT VOLTAGE DOMESTIC	120 Vac/60 Hz (nominal), 104-132 Vac, 47-63 Hz
INPUT VOLTAGE INTERNAT'L	230 Vac/50 Hz (nominal), 195-264 Vac, 47-63 Hz or 100 Vac/50 Hz (nominal), 88-112 Vac, 47-63 Hz
INPUT CURRENT	0.5 Amps maximum @ 100, 120 Vac 0.25 Amps maximum @ 220, 230, 240 Vac
AC FUSE REQUIREMENTS	100 Vac/50 Hz - 2 each, 0.5 Amp, 3AG, 125 Vac. 120 Vac/60 Hz - 2 each, 0.5 Amp, 3AG, 125 Vac. 220 Vac/50 Hz - 2 each, 0.25 Amp, FST, 250 Vac. 240 Vac/50 Hz - 2 each, 0.25 Amp, FST, 250 Vac.
DC FUSE REQUIREMENTS	Battery Fuse - 1 each, 2.0 Amp, FST, 250 V.
BATTERY	12 volt, 2.4 Amp-hour, sealed lead acid.

Table 1-9. Performance Specifications

ITEM	SPECIFICATION
CUFF PRESSURE RANGE	Adult/Pediatric: 0 mmHg to 250 mmHg Neonatal: 0 mmHg to 210 mmHg ƒ0 mmHg to 158 mmHg
INITIAL CUFF INFLATION	Adult/Pediatric: 170 ± 15 mmHg Neonatal: 120 ± 15 mmHg ƒ98 ± 15 mmHg
BLOOD PRESSURE DETERMINATION RANGES	SYSTOLIC 30 to 245 mmHg (Adult/Pediatric) 30 to 190 mmHg (Neonates) MAP 20 to 225 mmHg (Adult/Pediatric) 20 to 170 mmHg (Neonates) DIASTOLIC 10 to 210 mmHg (Adult/Pediatric) 10 to 160 mmHg (Neonates) PULSE 30 to 200 bpm (Adult/Pediatric) 30 to 220 bpm (Neonates)
BLOOD PRESSURE ACCURACY	Blood pressure accuracy meets or exceeds proposed AAMI standards for non-invasive blood pressure accuracy. (AAMI Standard: ± 5 mmHg mean error, < 8 mmHg standard deviation as compared to central aortic pressure.)
STATIC PRESSURE ACCURACY	Displayed pressures will not vary by more than the greater of ± 3 mmHg or ± 2% from that of a mercury manometer in the range of 0 mmHg to 250 mmHg.
USER-ADJUSTABLE INFLATION RANGE (TARGET PRESSURE)	100 - 250 mmHg (Adult) 100 - 210 mmHg (Neonate)

ƒModel 9303 and Model 9343 Monitors only.

Table 1-9. Performance Specifications (Continued)

ITEM	SPECIFICATION
BLOOD PRESSURE DETERMINATION TIME	20 seconds to 45 seconds typical; 120 seconds maximum.
OVERPRESSURE CUTOFF	Adult/Pediatric: 300 mmHg, ± 20 mmHg Neonates: 235 mmHg, ± 10 mmHg 158 mmHg, ± 10 mmHg*f*
PULSE RATE ACCURACY	± 3.5 percent.
DISPLAYED TEMPERATURE RANGE†	ORAL/RECTAL: (Max.) 108.0° F (42.2° C) (Min.) 88.0° F (31.1° C)
TEMPERATURE ACCURACY†	Meets ASTM E1112-86: ± 0.1° C in the range of + 37.0° C to + 39.0° C. ± 0.2° F in the range of + 98.0° F to + 102.0° F.
TEMPERATURE DETERMINATION TIME†	Displayed after **TEMPERATURE START** switch is pressed: 30 seconds typical; 60 seconds maximum.
BATTERY CHARGING	Four hours in fast charge mode. Unit will operate and charge battery simultaneously when connected to an AC power source.
BATTERY OPERATING TIME	6 hours minimum operation (5 minute cycle time with adult cuff at 25° C.)

† Model 9340 Monitor only.
f Model 9303 Monitor only.

SECTION 2. PRINCIPLES OF OPERATION

2.1 INTRODUCTION

This section of the manual presents the principles of operation for the DINAMAP *XL* Vital Signs Monitors. Overall operation is described in paragraph 2.2. Descriptions of each functional system are expanded in paragraph 2.3. Refer to the component sections of this manual for schematic diagrams and principles of operation at the component level.

2.2 OVERALL PRINCIPLES OF OPERATION

A system block diagram of the DINAMAP *XL* Monitor is illustrated in Figure 2-1. Patient vital signs are measured by a variety of electronic sensors. NIBP sensor measurement operations are supervised by the system processor, which converts the results into visual presentations at the display.

Operator access is via buttons located on the front switch panel. A communications interface provides data interchange between the system processor and a host computer.

The Monitor includes a pneumatics system required for NIBP operation. Large deflation steps are employed for NIBP and the Monitor interpolates measurements between steps. The pneumatics system then regulates operation of the pneumatic pump and valves.

The Monitor can be powered from AC or a storage battery. The power supply rectifies AC power, recharges the battery, and provides regulated DC operating power to the Monitor. The battery charger provides fast charging for the battery.

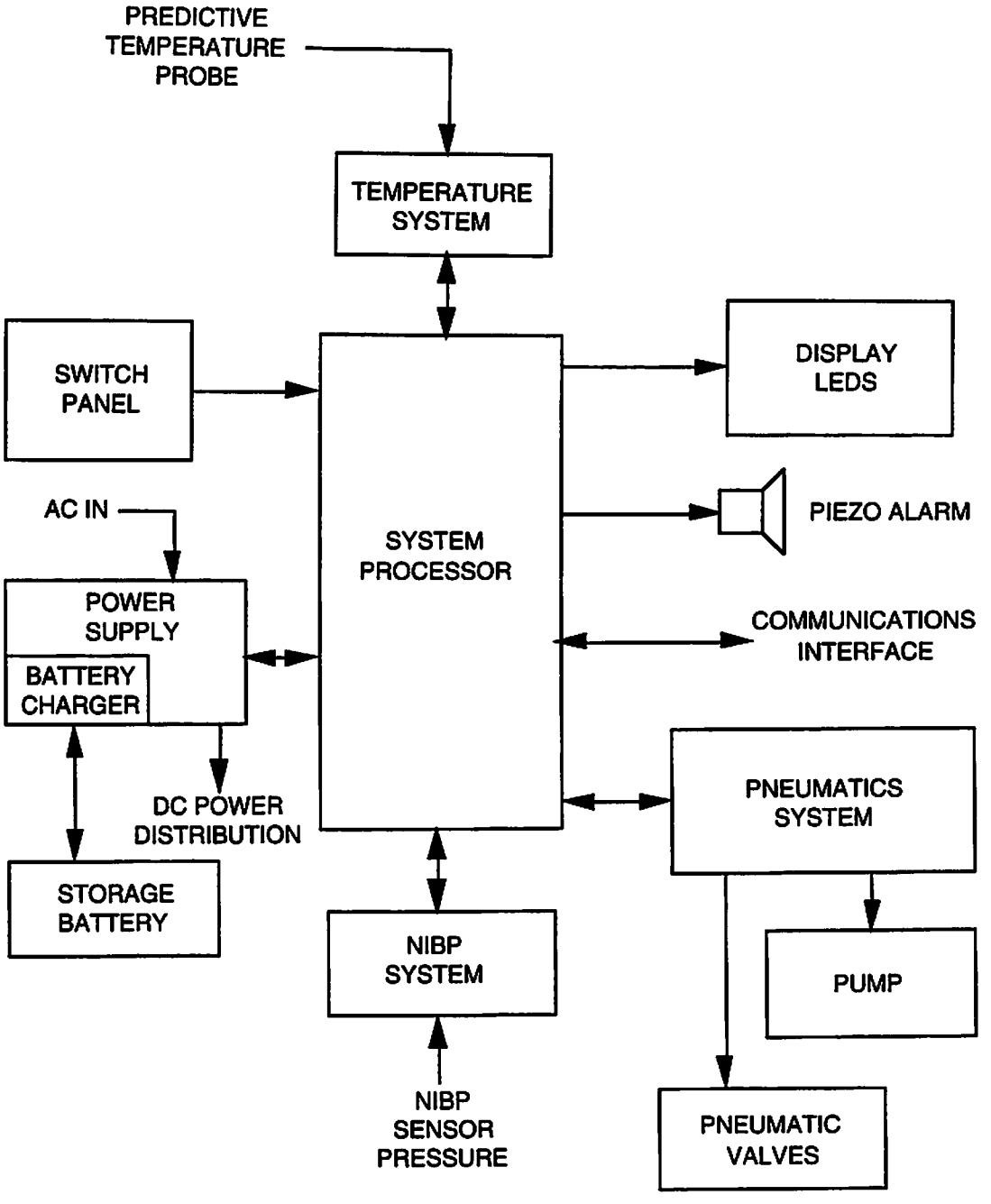


Figure 2-1. DINAMAP *XL* Monitor System Block Diagram

In addition to the above features of the Model 9300 Monitor, the Model 9340 Monitor has a temperature measurement system. Predictive measurement is based on a 12-minute mercury in glass reference. A 3-minute option is available by removing an internal jumper. Predictive probes can be connected to provide an analog signal representing the measured temperature. This analog signal is digitized by an A/D converter and this information is sent to the display for viewing (see Figure 2-1). The Model 9340 Monitor also provides for possible future digital connection to a tympanic probe.

2.3 FUNCTIONAL PRINCIPLES OF OPERATION

The DINAMAP *XL* Monitors comprise five functions. The following paragraphs describe each of the Monitor functions using a simplified block diagram. Foldout diagrams are located at the end of this section. Input and output sources and destinations and connector pin identifications are included as an aid to troubleshooting.

2.3.1 System Processor

The system processor, shown in Foldout FO-2A at the end of this section, is based on 6309 microprocessor U1 and 8Kx8 CMOS RAM U5. A master clock generated by U9 is divided into E and Q clocks by gate array U2 to provide system timing by U1. Communication between microprocessor U1 and all digital circuits is provided by a 16-bit address and 8-bit data bus.

The program is stored in 32Kx8 EPROM U4 offering 32K 8-bit words. Custom-designed gate array U2 provides high order address decoding, dividing the master clock to E and Q clocks, controlling the fail-safe timer reset pulse from U11, discrete digital I/O at U21, and display interface.

When an error or overpressure condition occurs, a pulse-modulated audio alarm signal is generated by the audio annunciator. The audio annunciator turns on a fixed-frequency audio piezo alarm and controls the volume of the alarm as a function of the signal duty cycle. The alarm also beeps at one-minute intervals when the battery is low. Failsafe timer circuit U11 is used in case the microprocessor fails to operate.

Analog temperature and NIBP data and power supply voltages are converted to digital data by U7 and processed by U1.

Display data is latched in U1 and U4 on the display PWA and stored there until the proper digit segments are selected by U7 and U8. When proper digits are selected display LEDs DS1 through DS36 are energized by the seven segment drivers U2, U3, U9, and U10.

When the unit is turned on, the fail-safe timer circuit on the system processor must be cleared by RESET from the power supply. If this does not happen, 4-second counter U22 generates a pneumatic reset to the pneumatics system and shuts down the unit.

Digital I/O U21 polls the front switch panel to detect if any buttons are pressed. This information is processed through digital I/O U21 to U1.

2.3.2 Temperature System

The temperature system (Foldout FO-2B) for the Model 9340 Monitor incorporates subsystems for reading tympanic (infrared) and thermistor probes.

If a thermistor probe is used, the resistance of the probe varies in relation to temperature. This resistance change alters calibration trees R42-R47 and R63-R66 through input selector U17 on the display PWA. The resultant voltage from U17 is applied to voltage-to-frequency converter (VFC) U16. The digital tone from the VFC is isolated from the unit by opto-coupler U18 and applied to digital I/O latch U21 for the system processor.

Although temperatures taken using a tympanic probe are displayed only at the probe, there is a future provision for digital information from the probe to be coupled to the Monitor via RFI L2 and Opto-coupler U11 on the display PWA. The output of the opto-coupler would then be applied directly to digital I/O latch U21 for the system processor.

A +9v power supply (Q1, Q2, T1 on the display PWA) is isolated from the monitor electronics and supplies power to opto-couplers U11 and U18, voltage-to-frequency converter U16, and 3.2v reference supply U15. The calibration tree and VFC are held stable by 3.2v reference supply U15.

2.3.3 NIBP System

The noninvasive blood pressure system (Foldout FO-2C) measures blood pressure and pulse rate.

To measure blood pressure, constant current generator Q1 and Q2 excites transducer TX1 to enable it to convert air pressure from the pneumatics system into an analog voltage. This voltage is amplified by differential amplifier U14. Unfiltered PTOUT from U14 is routed to the host communications interface for processing by a remote computer. Filtered output from U14 is clamped and digitized by A/D converter U7 and evaluated by the system processor. Pressure transducer offset PTEXV from constant current generator Q1 and Q2 is monitored by A/D converter U7. The system processor sets the offset to a known value and gives a digital readout of the offset.

To measure pulse rate, PTOUT from U14 is filtered by low pass filter U15 to extract the pulse component and applied to switchable gain amplifier U16. Digital output latch U8 switches U16 between adult and neonatal monitoring modes and the output is applied to high pass filter U15. The output from U15 (FPTOUT) is routed to the host communications interface for processing by a remote computer. The output from U15 is also clamped by U15, CR6, and CR7 to produce FPT. FPT is digitized by A/D converter U7 and evaluated by the system processor.

The system software includes an internal on-line self-test feature for the FPT channel at power-up and after each non-STAT mode determination.

2.3.4 Pneumatics System

The pneumatics system (Figure 2-2) provides air pressure for the NIBP cuff, manifolding for control of cuff pressure, and an overpressure signal to the system processor if the pressure exceeds 300 mmHg (300 mmHg in adult mode and about 158 mmHg in neonate mode for French pneumatics systems). The system comprises an air pump, check valve, overpressure switch, power control circuit, and three solenoid-operated pneumatic valves. Air from the pump is routed through the check valve and the dump valve to the cuff output manifold.

The pneumatics system provides control of the pump by commands received from the system processor. The pneumatics system block diagram is shown in FO-2D, located at the end of this section. The PUMP ON command from gate array U2 on the system processor is applied to pump control circuit U2 on the pneumatics PWA. The signal then activates pulse width modulator U1 to send a modulated 5kHz pulse to pump driver Q2. The pump driver controls the pump speed by regulating the pump voltage to the pump. If a deflate or fail-safe alarm signal is produced by the system processor, the pump control circuit shuts off the pulse width modulator and stops the pump.

Autozero valve MT1 allows cuff pressure to be applied to pressure transducer TX1 on the system processor in the NIBP system. When the processor sends a zero signal to zero driver Q3 on the pneumatics PWA, MT1 energizes to maintain cuff network pressure while allowing transducer TX1 to read ambient pressure.

Deflate valve MT2 on the pneumatics PWA normally remains energized by deflate driver Q1 maintaining cuff pressure to pressure transducer TX1 in the NIBP system. If the system processor produces a fail-safe alarm, a deflate signal, or an overpressure signal, deflate driver Q1 on the pneumatics PWA turns off and de-energizes deflate valve MT2. This ports the cuff network to the atmosphere deflating the NIBP system.

Dump valve MT3 on the pneumatics PWA is normally de-energized allowing the pump to be connected to the cuff network. A dump command from system processor digital output latch U8 will turn on dump driver Q4 on the pneumatics PWA. This will energize dump valve MT3 which will port the network to the atmosphere.

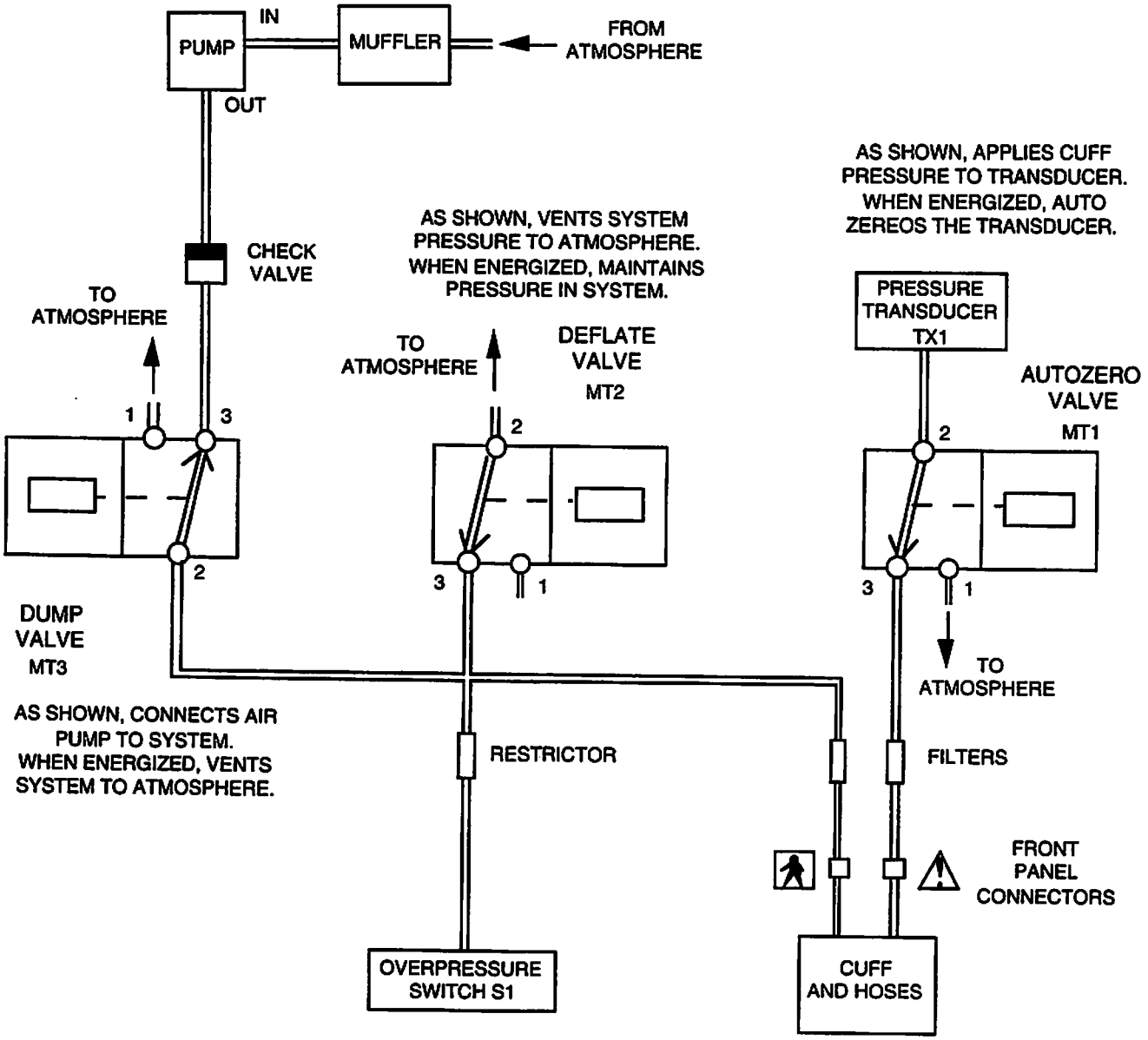


Figure 2-2. Pneumatics System Simplified Schematic

The current drain of all three valves is summed by average current sensing circuit R25-R27 on the pneumatics PWA and sent to the A/D converter on the system processor as VLVSENSE. This average current is measured by the system processor only for use by the factory during manufacturing tests.

On the standard pneumatic system when an overpressure condition occurs, overpressure switch S1 on the pneumatics PWA sets overpressure latch U3. This sends overpressure signal OP-1 to the system processor through digital I/O U21.

The OP-1 logic also turns on dump control Q7, which energizes dump valve MT3 and de-energizes the deflate valve MT2. Overpressure signal OP-1 is sent to the system processor via J3-12 which generates visual and audible overpressure alarms. U2, U3 on the pneumatics PWA also turns on Q7 during the overpressure condition to ensure the dump valve is energized if Q4 fails.

With a French pneumatics system, an overpressure PWA is used in place of overpressure switch S1 to provide a dual set point (300 mmHg for adults; about 158 mmHg for neonates) overpressure selection. Pressure from the CUFF port is applied to pressure sensor TX1 on the overpressure PWA. The output of the sensor is amplified and filtered at U2 and compared to one of two references at U3. The Adult-0/Neo-1 select line from U8 on the system processor chooses the appropriate reference for adult or neonate mode. Comparator U3 on the overpressure PWA outputs an overpressure signal to inverter Q2 to set overpressure latch U3 on the pneumatics PWA. This produces overpressure signal OP-1 which generates visual and audible overpressure alarms.

Once the cuff network has been deflated and the pump shut off, the pneumatics system can be reset by the system processor by PNEU_RESET. After a 4-second delay from system reset or CANCEL, U22 sends a pneumatic reset signal that clears the overpressure latch and clears the overpressure signal.

2.3.5 Power Supply

The power distribution system is shown in Figure 2-3 and a system block diagram of the power supply is shown in Foldout FO-2E. When AC power is connected, the power transformer supplies between 18 and 32 volts AC to full-wave bridge rectifier CR6 on the power supply PWA. Unregulated Vp supplies power to all regulated power supplies and the pump driver circuits. This voltage is higher than the battery voltage when AC power is applied. This reverse-biases CR5 and prevents current drain from the battery while AC power is applied. When AC power is removed, CR5 is forward-biased keeping Vp to approximately 13.5 volts DC from the battery.

The ON and OFF switches on the front panel are routed through the system processor PWA directly to ON/OFF latch U5. When the ON switch is pressed, the latch is set and switches on regulator U4. Switched power Vs from U4 is applied to reference oscillator U1A. The oscillator then excites the +5V and +8V regulated supplies which convert Vp to +5V and +8V for Monitor system power distribution (see Figure 2-3).

The AC input power is also rectified by CR8 and CR9 to derive Vbc which is regulated by battery charger circuit Q11 and Q6. The system processor monitors Vbc through a voltage divider at A/D converter U7. The battery charger circuit is powered by Vp and referenced by Vbc producing battery charging voltage Vb. Vb provides a trickle charge for the battery through fuse F1 unless fast battery charger circuit U1 is activated.

The power supply has a current limited, dual rate, dual current battery charger to reduce charging time from 16 hours to approximately four hours. Fast battery charger circuit U1 uses +5v as a reference to control battery charging. If the charging current exceeds 50 mA, fast battery charger circuit U1 turns on and applies approximately 14.7 volts to the battery. This increases the charging current to 400 mA (650 mA if the unit is off). When the charging current drops to approximately 40 mA, fast battery charger circuit U1 turns off, returning the circuit to a trickle state of approximately 20 mA to maintain battery charge.

Battery switch Q7 uses the +8v supply to connect the battery to a voltage divider circuit to produce Vbs. Vbs is routed to the system processor for monitoring. When power is off, Q7 is switched off disconnecting the battery from the voltage divider network, eliminating current drain from the battery.

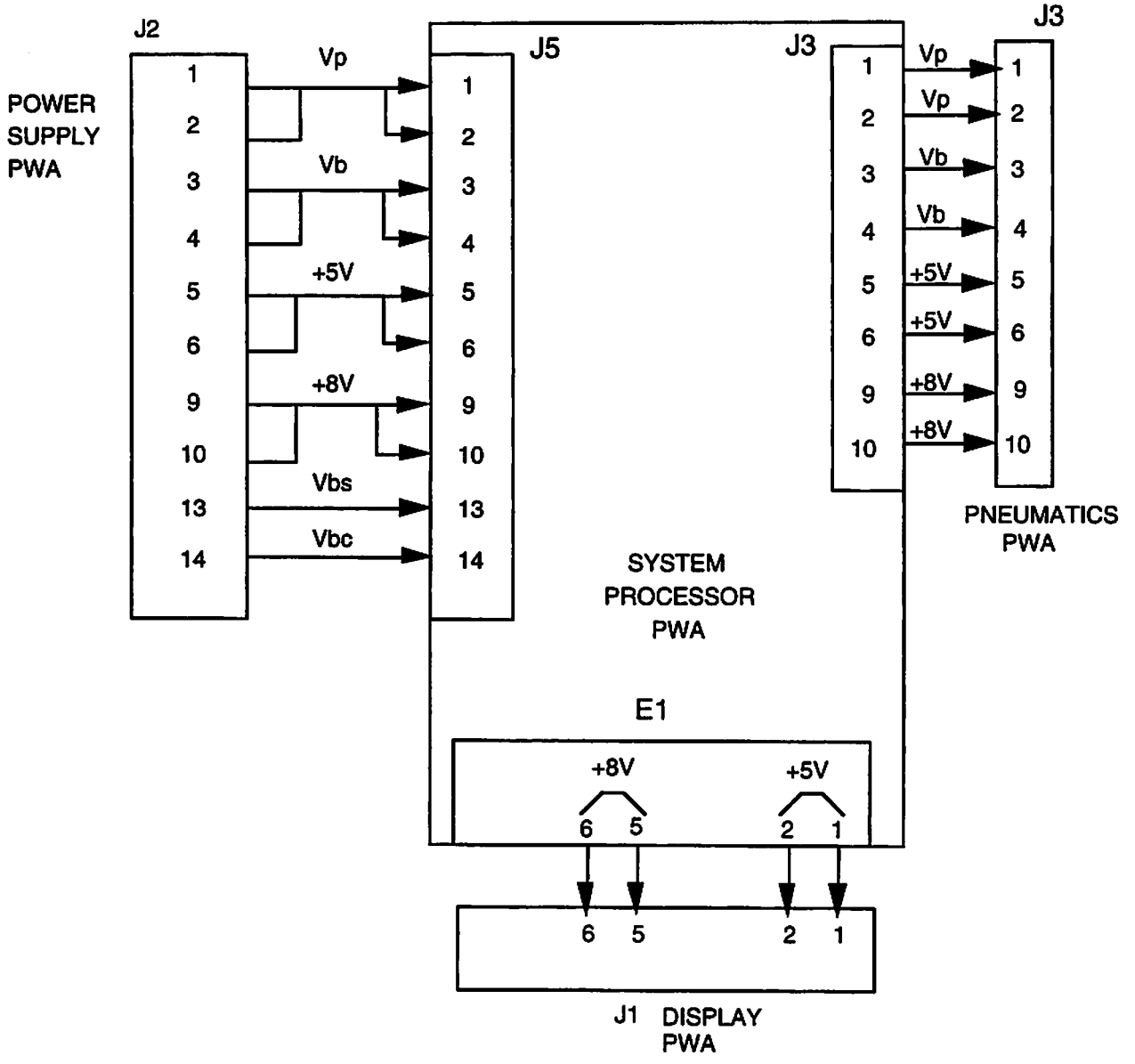


Figure 2-3. Power Distribution Diagram

2.3.6 Remote Computer Protocol

The Monitor can receive commands from and send data to a remote computer at 600 baud. The host computer interface is shown in Table 2-1.

Table 2-1. Host Computer Interface

SIGNAL	J1 PIN #
PT_OUT	8
FPT_OUT	9
TXE-1	4
RXR-1	5
AUXOUT-0	11
AUXIN-0	12
RXD-0	3
TXD-0	2
+5VSWITCHED	10
+5VCTL	13
GROUND	7

Word format is 8N1 (eight bits, no parity, and one stop bit). The Monitor stays in the receive mode until the remote computer transmits a valid command. Before transmitting a command, the host computer should transmit an ASCII carriage return to clear the Monitor receiver. A valid command is an ASCII character string in one of the following formats:

ASCII FORMAT	COMMAND TYPE
BAA<cr>	Return B.P. Status
BAB<cr>	Start B.P. Determination
BAC<cr>	Return Alternate B.P. Status
BAD<cr>	Return B.P. Alarm Limits
BAE<cr>	B.P. AUTO/MANUAL
BAF<cr>	(reserved for future use)
BAG<cr>	B.P. CANCEL Switch
BAH[t][hhh][lll]<cr>	Change B.P. Alarm Limits
BAI[cc]<cr>	Set CYCLE TIME
BAJ<cr>	Unlock KeyPWA
BAK<cr>	Lock KeyPWA
DAA<cr>	Return Temperature Status†
DAB<cr>	START a NORMAL Temp. Prediction†
DAG<cr>	RESET a NORMAL Temp. Prediction†
DAU<cr>	Switch Temp Units (°F to °C/°C to °F)†

†Model 9340 Monitor only.

For more information about host computer protocol, refer to DINAMAP Vital Signs Monitors Host Communications Reference Manual 776-632.

SECTION 3. GENERAL MAINTENANCE

3.1 INTRODUCTION

This section of the manual contains procedures for changing fuses, using calibration modes for periodic checks of DINAMAP *XL* Monitor operation, making adjustments, and isolating faults

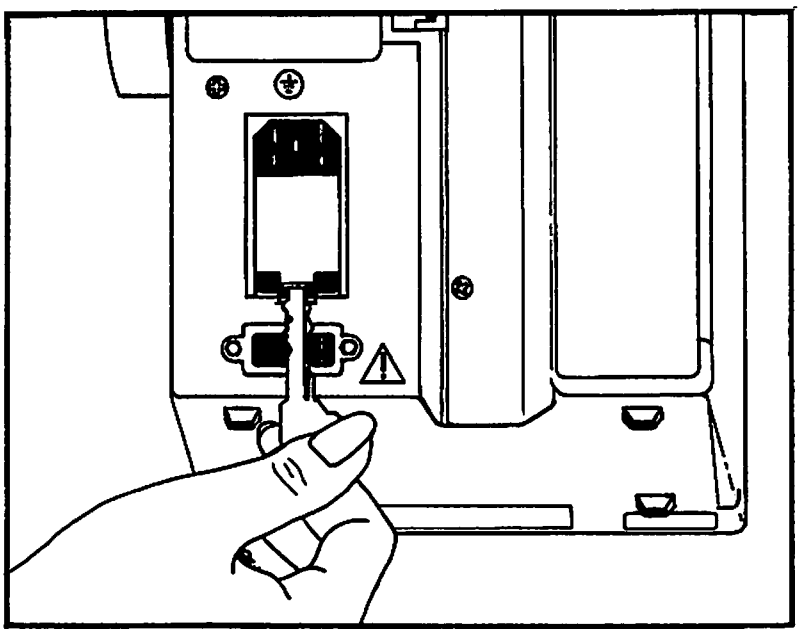
Procedures that pertain to temperature determinations apply only to the Model 9340 Monitor.

3.2 CHANGING FUSES

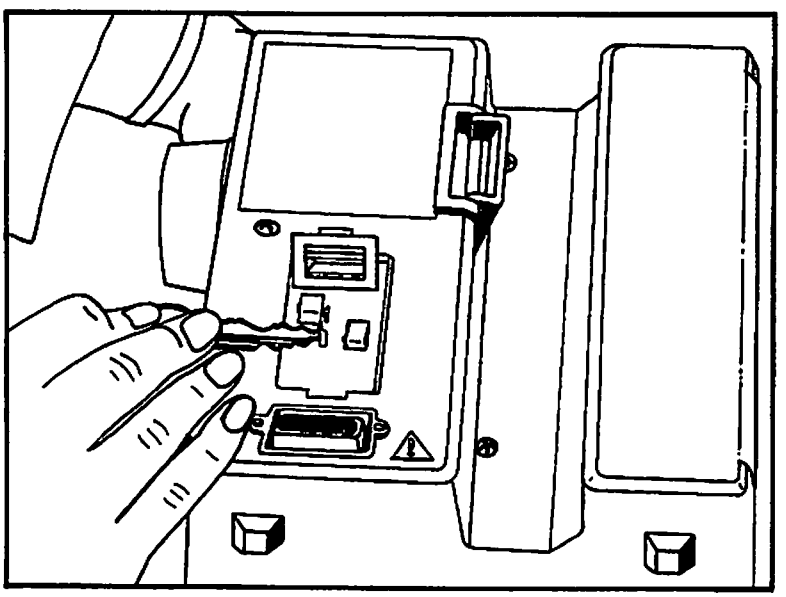
The Monitor contains three fuses. Two AC line power fuses are contained in the power entry module. One battery fuse is contained on the power supply PWA and is accessible only after removing the rear case.

3.2.1 Replacement of Line Power Fuses

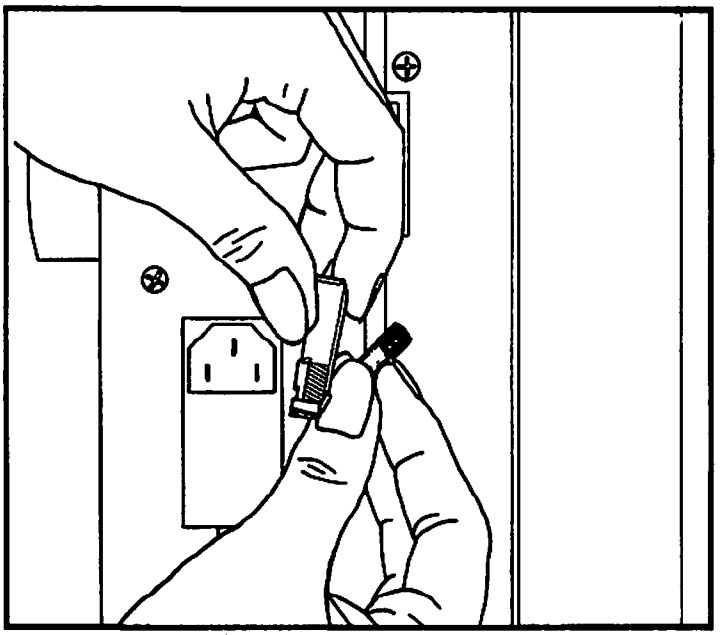
If attached, remove the power cord at the rear of the Monitor. Using a flat bladed tool such as a screwdriver or key, pry up the lower edge of the door below the power connector and swing the door upward on its hinge to reveal the two fuse holders.



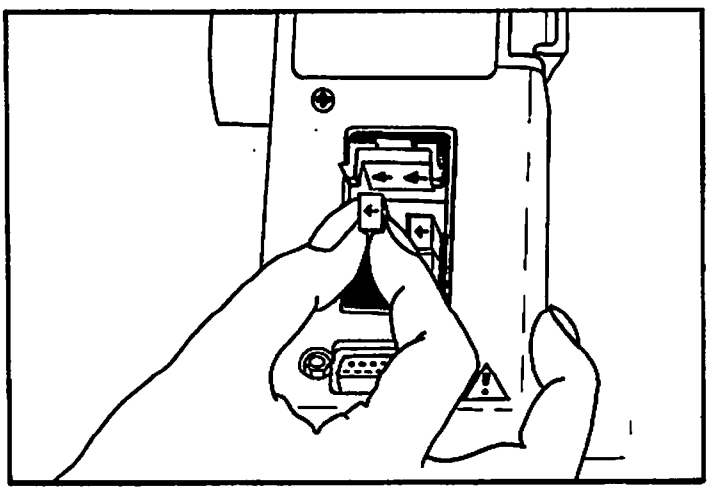
Using the same tool, pry out each fuse holder.



Remove each fuse from its fuse holder and inspect it for a burned or broken filament. If the filament appears to be intact, check it for continuity with an ohmmeter. Replace the blown fuse with one of the specified rating and type.



Reinstall the fuse and fuse holder. Make sure that the arrows on the outward facing ends of the fuseholders are pointing in the same direction as the arrows on the inside of the cover plate. Snap down the cover plate.



3.2.2 Replacement of Battery Fuse

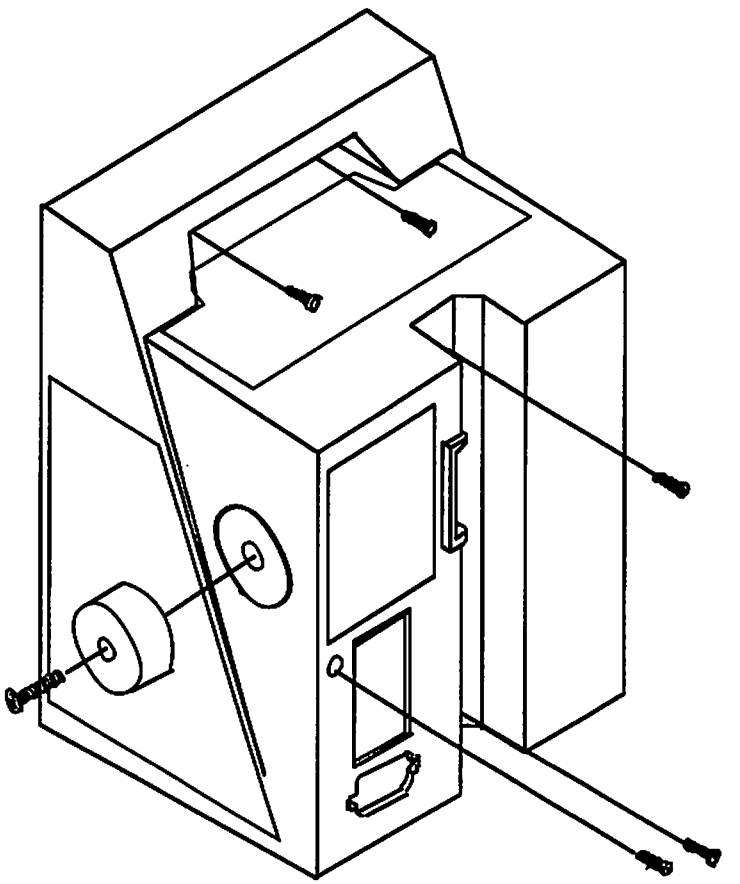
If attached, remove the power cord at the rear of the Monitor. Switch power off at the front panel. Using a Phillips screwdriver, remove the pole clamp knob screw and the five cover hold-down screws.

NOTE

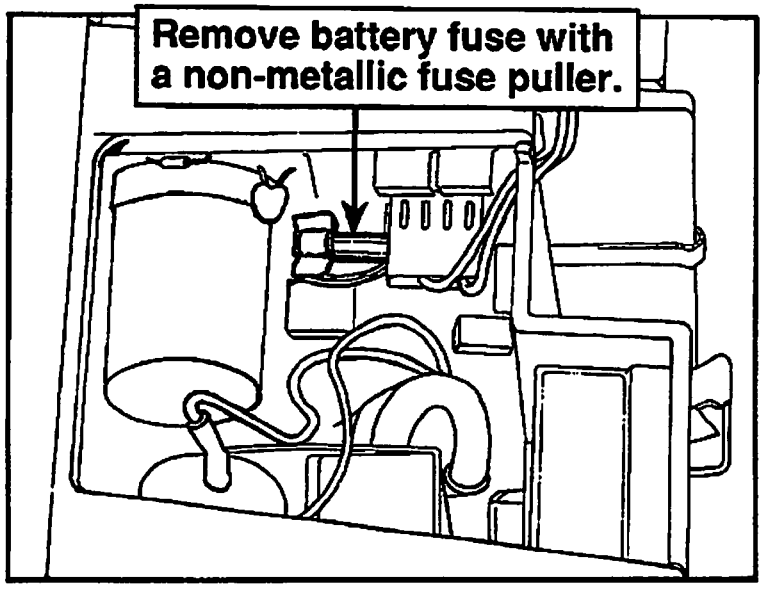
Rotate the pole clamp knob fully counter-clockwise to retract the pole clamp completely before attempting to remove the back cover.

CAUTION

Do not attempt to pry off the back cover with a screwdriver, or damage to the CPU board may result. If the pole clamp is fully retracted and all five screws are removed, the cover should slide off easily.



Remove the pole clamp knob and the rear cover. Disconnect the battery cable spade lug. Locate the battery fuse and remove it with an insulated fuse puller, or equivalent. Inspect the fuse for a burned or broken filament. If the filament appears to be intact, check it for continuity with an ohmmeter. Replace the blown fuse with one of the specified rating and type.



3.3 CALIBRATION MODES OF OPERATION

Five calibration modes of operation are provided for viewing certain internal operating parameters on the front panel displays and for exercising the digital displays. Modes 1 through 4 apply to both Model 9300 and Model 9340 Monitors. Mode 5 is for temperature functions and only applies to the Model 9340 Monitor.

To place the Monitor in the calibration mode, press **OFF** then press and hold **SET** while pressing **ON**. Continue to hold **SET** for 4 seconds. The Monitor then enters calibration mode 1. The Monitor performs an autozero each time it changes calibration modes. The Monitor increments through the modes each time you press **SET**, wrapping around from the last mode to calibration mode 1 and so on. The Monitor automatically returns to the **MANUAL** mode at the end of three minutes. The Monitor will stay in calibration mode indefinitely, or until you press **CANCEL**, if you continue to hold **SET** for 20 seconds instead of 4. A short beep sounds after 20 seconds.

On the Model 9340 Monitor, the **MAP** display is replaced by the **TEMPERATURE** display.

3.3.1 Calibration Mode 1

Press and hold **SET** while pressing **ON**. Continue to hold **SET** for 4 seconds. The Monitor then enters calibration mode 1 and performs an auto-zero. Observe the following information in the four main digital displays (a flashing 88 is shown in the **B.P. CYCLE MINUTES** window):

MAP Display. The **MAP** display (**TEMPERATURE** display on Model 9340 Monitor) shows pressure in mmHg applied to the **CUFF** ⚠ port. If this port is open to atmosphere, the display should be 0, +1/-0.

PULSE Display. The **PULSE** display shows a numeric code representing the alphabetical revision level of the software installed in the Monitor EPROM. These numeric codes are defined in Table 3-1.

Table 3-1. Software Revision Level Numeric Codes

MINOR REVISION LETTER

(typically indicates an enhancement or bug fix since the previous revision)

MAJOR REVISION LETTER

(Indicates significant redesign and/or hardware incompatibility with other versions)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
B	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
C	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
D	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
E	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129
F	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
G	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181
H	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
I	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233
J	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259
K	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
L	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311
M	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337
N	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363
O	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389
P	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415
Q	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441
R	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467
S	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493
T	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519
U	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545
V	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571
W	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597
X	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623
Y	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649
Z	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675

SYSTOLIC Display. The **SYSTOLIC** display shows battery bus voltage Vb in volts with no decimal point. The display may be anything from 104 (10.4 Vdc) to 150 (15.0 Vdc) depending on the charge of the battery and whether or not battery charger **MAINS AC** is on. Voltages under 11.8 Vdc indicate low battery and are flashed along with the **BATTERY** indicator.

DIASTOLIC Display. The **DIASTOLIC** display shows the transducer excitation voltage at TP18 on the system processor PWA. Normal readings should be between 81 (0.81 Vdc) and 99 (0.99 Vdc). Readings outside this range causes the display to flash.

Typical normal displays are shown in Figure 3-1.

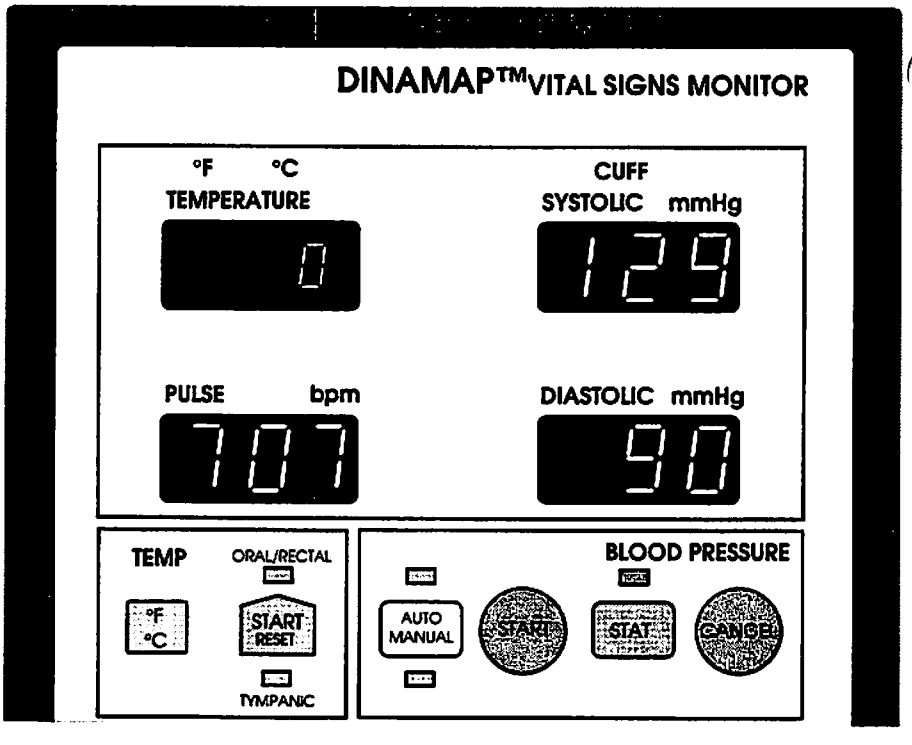


Figure 3-1. Typical Calibration Mode 1 Displays

3.3.2 Calibration Mode 2

Press **SET** a second time to place the Monitor in calibration mode 2. Observe the following information in the four, main digital displays (a flashing 88 is shown in the **B.P. CYCLE MINUTES** window):

MAP Display. The **MAP** display (**TEMPERATURE** on the Model 9340 Monitor) shows pressure in mmHg applied to the **CUFF** ⚠ port. If this port is open to atmosphere, the display should be 0, +1/-0.

PULSE Display. The **PULSE** display shows the zero offset applied by the microprocessor during the autozero. This value may range from -50 to -1 mmHg depending on the environmental temperature and the drift characteristics of the transducer and amplifier circuit. At room temperature, this range should be -18 to -32. Typically, this is -25.

SYSTOLIC Display. The **SYSTOLIC** display shows filtered pressure transducer FPT dc offset in A-to-D units. Typically, this value is 10 ±1. If this value is out of range, it is an indication that the FPT amplifier circuitry is faulty.

DIASTOLIC Display. The **DIASTOLIC** display shows the output of the pressure channel when 50 mmHg offset signal DASH50-1 is applied. This should be in the range of 49 to 53 (typically 51). This offset is checked every time an auto-zero is performed. For readings outside this range, the microprocessor generates a 924 hardware alarm.

Typical normal displays are shown in Figure 3-2.

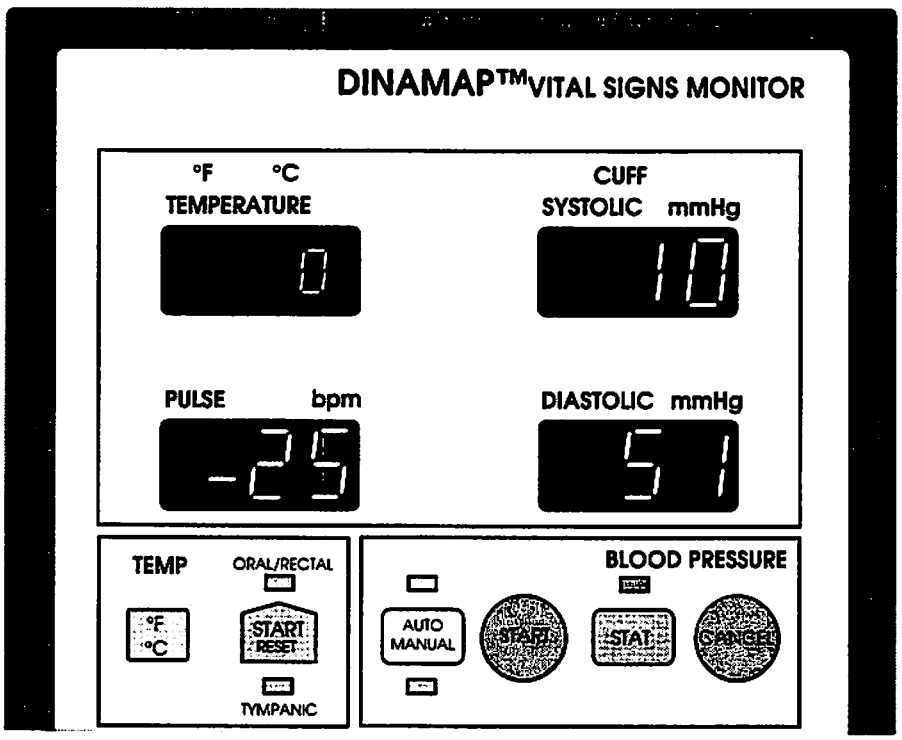


Figure 3-2. Typical Calibration Mode 2 Displays

3.3.3 Calibration Mode 3

Press **SET** a third time to place the Monitor in calibration mode 3. Observe the following information in the four, main digital displays (a flashing 88 is shown in the **B.P. CYCLE MINUTES** window):

MAP Display. The **MAP** display (**TEMPERATURE** on the Model 9340 Monitor) shows the measured +5 Vdc supply. The normal range of the display is 46 (+4.6 Vdc) to 54 (+5.4 Vdc). Values outside this range causes the display to flash and causes the microprocessor, during normal operation, to generate the 911 hardware alarm.

PULSE Display. The **PULSE** display shows the measured -6 Vdc supply. The normal range of the display is -50 (-5.0 Vdc) to -80 (-8.0 Vdc). Values outside this range causes the display to flash and causes the microprocessor, during normal operation, to generate the 913 hardware alarm.

SYSTOLIC Display. The **SYSTOLIC** display shows the measured +8 Vdc supply. The normal range of the display is 72 (+7.2 Vdc) to 88 (+8.8 Vdc). Values outside this range causes the display to flash and causes the microprocessor, during normal operation, to generate the 912 hardware alarm.

DIASTOLIC Display. The **DIASTOLIC** display shows battery charging voltage Vbc. The normal range of the display is 0 (0 Vdc) to 320 (+32.0 Vdc) depending on the state of charge of the battery and the AC line voltage and whether or not the AC power is applied to the Monitor.

Typical normal displays are shown in Figure 3-3.

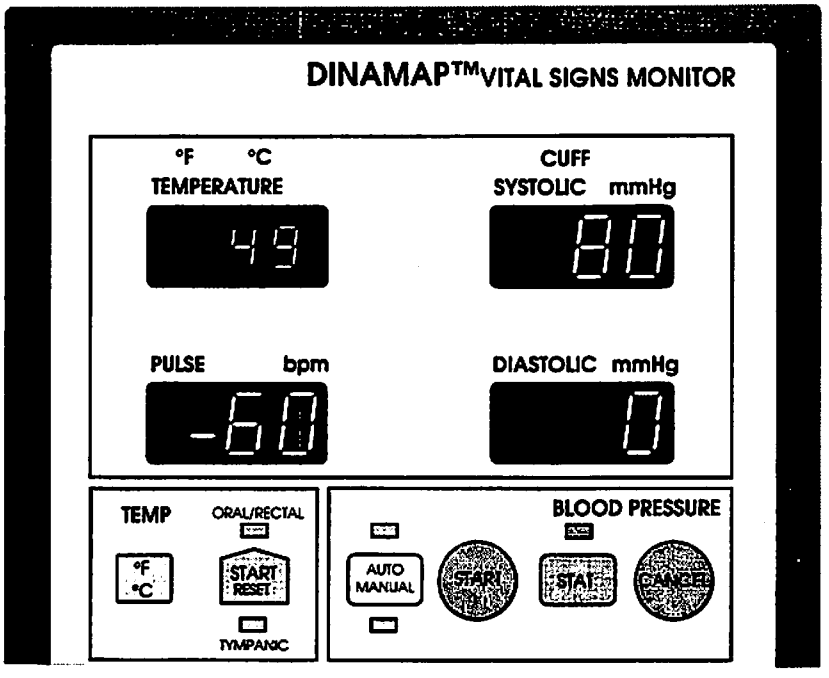


Figure 3-3. Typical Calibration Mode 3 Displays

3.3.4 Calibration Mode 4

Press **SET** a forth time to enter calibration mode 4. Observe that all front panel LEDs are exercised in the following sequence:

SEQUENCE	ACTION
1	Displays zeroes in all the digital displays.
2	Displays ones in all the digital displays.
3	Displays twos in all the digital displays.
4	Displays threes in all the digital displays.
5	Displays fours in all the digital displays.
6	Displays fives in all the digital displays.
7	Displays sixes in all the digital displays.
8	Displays sevens in all the digital displays.
9	Displays eights in all the digital displays.
10	Displays nines in all the digital displays.
11	Displays a "walking eight" in all the digital displays.
12	Sequentially turns on and off each point LED and then repeats the sequence starting with 1.

3.3.5 Calibration Mode 5

On the Model 9340 Monitor, press **SET** a fifth time to place the Monitor in calibration mode 5.

NOTE

The Model 9300 has no mode 5 and returns to mode 1 if the **SET** key is pressed again.

The Monitor is now in state 1 as shown in Table 3-2. You may select different temperture measurement channels by pressing **HIGH** to increment or **LOW** to decrement through states 1, 2, 3 or 4. As you select states 1 through 4, observe the **TEMPERATURE** window for the number of transitions during a 1.5 second time frame and the corresponding offset window and value.

Table 3-2. Calibration Mode 5 Channel Selection

STATE	CHANNEL	NOMINAL TEMPERATURE WINDOW DISPLAYS	OFFSET		VFC TRANSITIONS UPDATED
			WINDOW	NOMINAL VALUE	
1	3	N/A	SYSTOLIC, DIASTOLIC, and PULSE TEMP-ERATURE	0	once
		0 with no probe; 956 with cal plug attached		depends on temperature input connection	every 1.5 sec
2	0	57	SYSTOLIC	0	every 1.5 sec
3	1	948	DIASTOLIC	0	every 1.5 sec
4	2	1154	PULSE	0 with blue probe -30 with red probe	every 1.5 sec

3.4 PERIODIC MAINTENANCE

Periodic maintenance tasks include cleaning the Monitor, checking pressure calibration, checking for pneumatic leaks, checking the overpressure cutout switch, and checking the temperature calibration.

3.4.1 Monitor Cleaning

The exterior of the Monitor may be wiped clean with a cloth slightly dampened with mild detergents or normal hospital bactericides.

- Do ***not*** immerse unit.
- Do ***not*** clean with isopropyl alcohol or other solvents.
- The adult cuffs supplied for use with this Monitor may be cleaned by hand washing in warm soapy water. Care should be exercised, however, to ensure that no water enters the cuff or cuff hoses at any time. Should water accidentally enter the cuff it may be dried by passing air through the cuff.
- The neonatal cuffs are supplied for single use and should be discarded if they become soiled.
- Do ***not*** immerse hoses.
- Do ***not*** immerse cuffs without prior application of cuff hose caps.

CAUTION

Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced into the pneumatic system can cause damage to the unit.

- The probe holder may be removed and cleaned with a mild detergent. The probe holder may be immersed during cleaning.
- Do ***not*** immerse temperature calibration plug.
- The probe may be cleaned with an alcohol solution. Use a cloth or sponge, just damp, ***not*** wet, and avoid getting any liquid into the interior of the probe.

3.4.2 Care of the Storage Battery

The storage battery specified for use with the Monitor is a sealed lead-acid battery.

NOTE

For maximum battery life, the battery should be fully charged as soon as possible after each use.

The expected battery life cycle is largely dependent on the way the battery is used. If a discharged battery is fully recharged soon after use, the battery should last a minimum of two hundred recharge cycles. If a battery is used in the top one third of its charge and fully charged whenever possible, up to twelve hundred cycles can be expected, approximately six times the number of cycles of a battery used to 100% capacity.

A battery that has been fully discharged can be fully charged by the Monitor in less than six hours.

The Monitor attempts to charge the battery when it is connected to an external AC power source, even if the Monitor is off. If the battery is already completely charged, the monitor maintains the battery's condition.

NOTE

Storage of batteries at temperatures above 77° F (25° F) can dramatically increase the rate of self discharge for the battery.

Take care not to leave the battery in a discharged state for any extended period of time, as the normal life of the battery may be drastically reduced.

One fully charged battery supplies enough energy to operate the Monitor for a minimum of six hours. This operation would include temperature and non-invasive blood pressure determinations at five minute intervals.

3.4.3 Blood Pressure Calibration Check

Pressure calibration of the Monitor should be checked at least once every twelve months or when there is doubt about the validity of the pressure readings. To perform a calibration check, follow these procedural steps:

CAUTION

Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced into the pneumatic system can cause damage to the unit.

1. Obtain the calibration kit (part number 320-246).

2. Connect a manometer to the Monitor using the parts supplied with the calibration kit as shown in Figure 3-4. In calibration procedure, use an adult cuff and air hose.

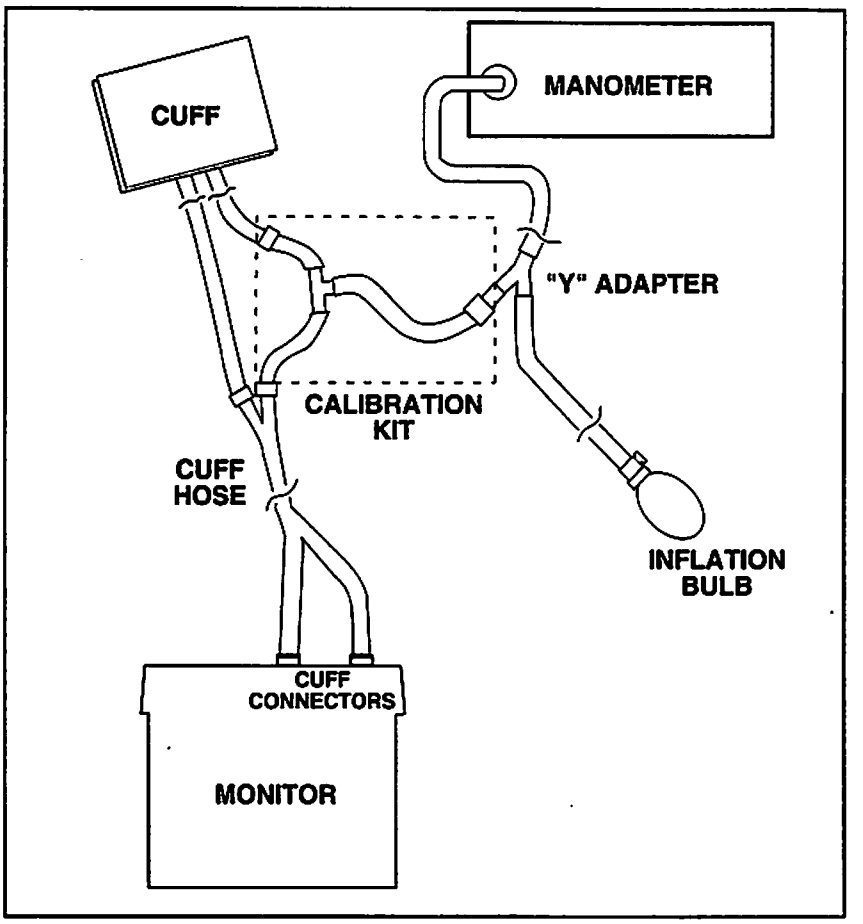


Figure 3-4. Pressure Calibration Check Setup

3. Plug the Monitor into the specified line power outlet.

4. Fold the adult cuff in such a way that the index line is aligned with the inner range mark on the inside of the cuff.

5. Press front panel **OFF** switch then press and hold the **SET** switch in for 4 seconds while pressing the front panel **ON** switch. Flashing 88s in the **CYCLE MINUTES** display indicate that calibration mode has been entered. The Monitor exits calibration mode if the **CANCEL** switch is pressed or after 3 minutes of inactivity. To remain in calibration mode indefinitely, hold the **SET** key for 20 seconds. The Monitor sounds a short audio tone and remain in calibration mode until **CANCEL** is pressed. Cuff pressure is displayed in the **MAP** display (**TEMPERATURE** display on the Model 9340 Monitor). Allow the Monitor to stabilize for about 30 seconds, then press **SET** five times to perform an auto-zero operation.

6. Using the inflation bulb, manually pump up the pressure to 200 ± 1 mmHg, as indicated on the **MAP** display and close pneumatic release valve on manometer bulb.

7. Verify that the pressure indicated in the **MAP** display does not change more than 5 mmHg in 60 seconds.

NOTE

If the leakdown is greater than 5 mmHg in 60 seconds, isolate the source of the leak to either the cuff and hose or the Monitor using cuff and hose leak test procedure which follows.

8. Repeat step 6 for pressures of 150, 100, and 50 mmHg and verify the following for each measurement:

   MAP display = manometer display ± 3 mmHg.

9. If the indicated pressures are not within tolerance, the Monitor must be calibrated. Refer to paragraph 3.5.4 for calibration.

3.4.4 Cuff and Hose Pneumatic Leak Check

1. Obtain the calibration kit (part number 320-246).
2. Connect a manometer with the parts supplied in the blood pressure calibration kit as shown in Figure 3-5.

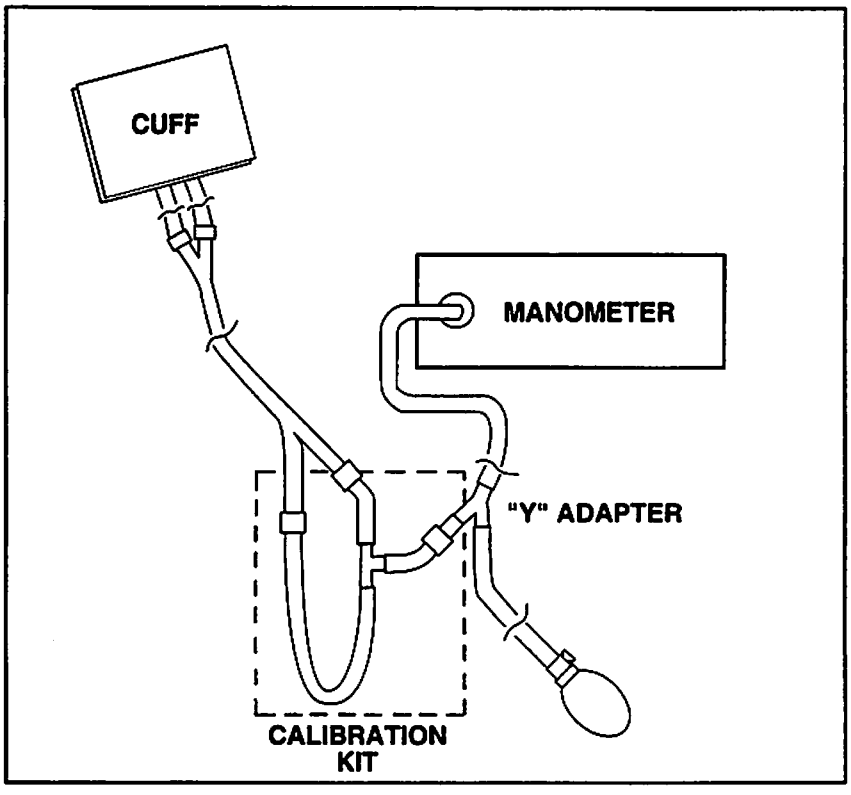


Figure 3-5. Cuff and Hose Leak Check Setup

3. Close the pressure release valve on the manometer inflation bulb and slowly pump up the pressure to 200 ±1 mmHg, as indicated by the manometer.

4. Verify that the manometer pressure does not fall by more than 5 mmHg in 60 seconds. If it does, either the cuff or hose or both are defective. If the cuff and hose pass this test, reconnect as shown in Figure 3-4 and place the Monitor in Calibration mode 2. Pump up the cuff and hose to 200 ±1 mmHg, and perform the same leak check to determine if the leak is, in fact, in the Monitor. Perform this leak check for all cuff and hose combinations used with the Monitor.

3.4.5 Overpressure Safety Check

1. Obtain the calibration kit (part number 320-246).
2. Connect a manometer to the Monitor using an adult cuff (reorder number 2774) and the 12 ft. hose (reorder number 8841) with the parts supplied with the calibration kit as shown in Figure 3-4.
3. Place the Monitor in calibration mode 2.
4. If the unit is a French Model 9303 Monitor, press the **LOW** button three times to ensure that the Monitor is in the adult mode -- disregard any error indications. Close the valve on the manometer inflation bulb and slowly inflate the cuff. Verify that somewhere in the pressure range of 270 to 330 mmHg, the Monitor deflates the cuff and generates a flashing 800 alarm in the **PULSE** display. If the overpressure cutout does not occur within this range, perform the overpressure adjustment procedure in paragraph 3.5.5 or 3.5.6. Open the bulb inflation valve to release the pressure.
5. If the unit is a French Model 9303 Monitor, press the **HIGH** button three times (this places the Monitor in the neonate mode). Close the valve on the manometer inflation bulb and slowly inflate the cuff. Verify that at approximately 158 mmHg, the Monitor deflates the cuff and generates a flashing 800 alarm in the **PULSE** display. If the overpressure cutout does not occur within this range, perform the overpressure adjustment procedure in paragraph 3.5.6. Open the bulb inflation valve to release the pressure.

3.4.6 Temperature Calibration Check

Predictive temperature calibration of the Model 9340 Monitor should be checked every 12 months or when there is doubt about the validity of the temperature readings. The temperature calibration plug (part number 320-635) may be used to check the calibration of the temperature detection circuits within the Monitor.

CAUTION

DO NOT twist the calibration plug when inserting or removing it since this may damage the precision resistors contained within the plug.

NOTE

The calibration plug contains an internal resistor that must be verified every time the Monitor is calibrated. Using a calibrated multimeter, the resistance between pins 1 and 2 of the calibration plug should be 6090 ±7Ω. If the plug is not within this range, replace it.

To check the calibration, insert the plug into the temperature **PROBE** connector on the front of the Monitor as shown in Figure 3-6 and press **ON**. Press **START**. After determination (approximately 60 seconds), the **TEMPERATURE** display should show 98.6 ±0.1°F, or 37.0 ±0.1°C. If the display is off by more than ±0.1 degree, the Monitor is out of calibration and should be calibrated. Refer to Paragraph 3.5.7 for calibration procedures.

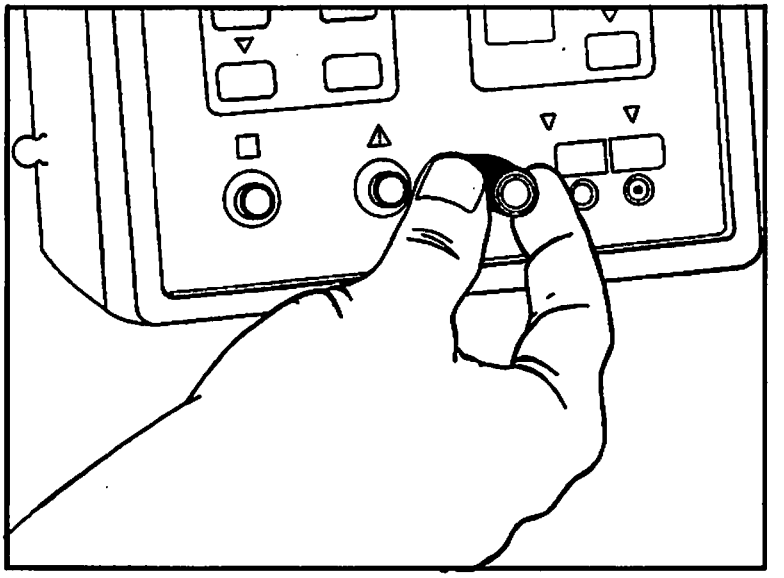


Figure 3-6. Connect Calibration Plug

3.4.7 Battery Fast Charge Check

Make sure the battery is fully charged by leaving the unit plugged in to AC power for approximately five hours. Refer to paragraph 3.3.1 to place the unit in the calibration mode 1. Observe the number in the systolic window to be approximately 138 (13.8 volts). This means the charger is in the trickle charge state.

Leave the unit in calibration mode 1 and unplug the AC power cord for about 30 seconds. After reconnecting the power cord, observe the number in the systolic window. Within a few minutes it should read approximately 148 (14.8 volts), verifying the fast charge voltage and current limit.

A few minutes after the number in the systolic window reaches its maximum it should quickly change back to 138, verifying the charger has returned to the trickle charge state.

NOTE

As the battery voltage settles the number may drop slowly from 143 to 138 but it should happen within a minute.

If the fast charge circuit does not perform as outlined above, refer to Paragraph 3.5.2 for calibration procedures.

3.5 ALIGNMENT AND ADJUSTMENT

Before attempting any alignment or adjustment procedures, the equipment listed in Table 3-3 must be made available for use. Most test points and adjustments can be accessed only by removing the rear cover. However, some of the units may require that the frame assembly housing the power supply and pneumatics PWA be removed and electrically connected to the system processor PWA via the optional extender cables listed in Table 3-3. In all cases, these extender cables provide for easier test point access and troubleshooting to the component level.

Table 3-3. Alignment and Adjustment Equipment List

EQUIPMENT	MANUFACTURER	MODEL
Digital Voltmeter	Fluke	8020 (or equiv.)
Calibration Kit	J & J Medical	320-246
Calibration Plug	–	320-635
Digital Manometer*	Druck	DPI260 (or equiv.)
0.050" Hexagonal Wrench	Allen	0.050"
Phillips Screwdriver	–	–
681 ohm, 1%, 1/2 watt resistor	–	–
150 ohm, 5%, 2 watt resistor	–	–
24 ohm, 5%, 16 watt resistor	–	–
10 ohm, 5%, 5 watt resistor	–	–
5.1 ohm, 1%, 1/4 watt resistor	–	–
1000 µf, 35 volt capacitor	–	–
9" Tuning Wand	GC Electronics	388SO020
Set of Extender Cables**	J & J Medical	300-607

* Manometer must have a range 0 - 400 mmHg or greater.

** These are optional and may be obtained through Customer Support to facilitate system processor PWA adjustments and troubleshooting.

3.5.1 Five Volt Logic Supply Adjustment

The +5 Vdc logic supply is adjusted by R13 on the top edge of the power supply PWA as shown in Figure 3-7. The voltage supply may be monitored at many locations on the PWAs or the extender cables but perhaps the easiest location for the voltmeter to be connected is the jumper locations at the bottom of the system processor PWA.

Perform the following procedure:

1. Connect the positive lead of the voltmeter to the ~~outside~~ inside connector of JP12 on the system processor PWA.

2. Connect the negative lead of the voltmeter to the outside connector of JP19 on the system processor PWA.

3. Ensure that a charged battery is installed in the Monitor or that the AC power supply is connected.

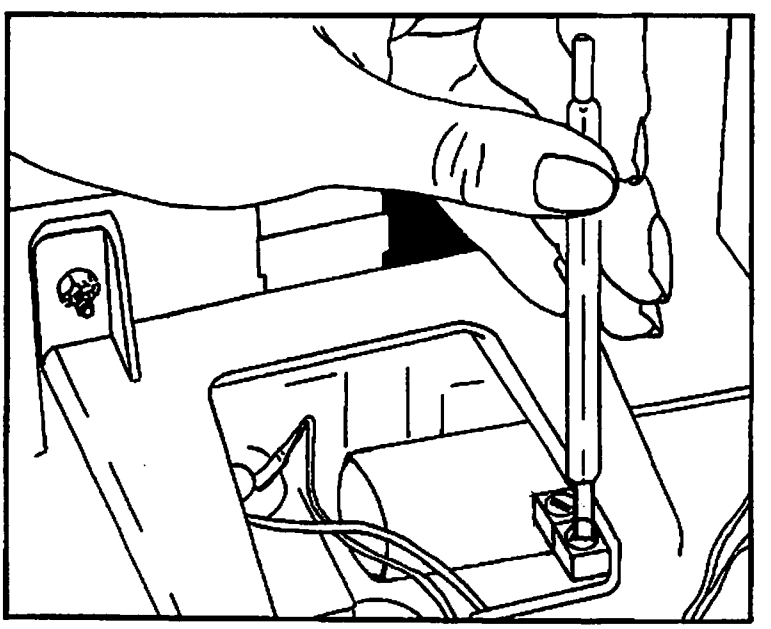


Figure 3-7. +5 Volt Logic Supply Adjustment

4. Press the **ON** switch on the front of the Monitor.

5. The voltmeter should read +5.05 ±0.05 Vdc. Adjust R13 on the power supply PWA to obtain this reading.

3.5.2 Battery Charger Float Voltage Adjustment

A test fixture may be built from the schematic shown in Figure 3-8 to make testing and adjusting the power supply easier. Except for the switches, these parts should be available from the list shown in Table 3-3.

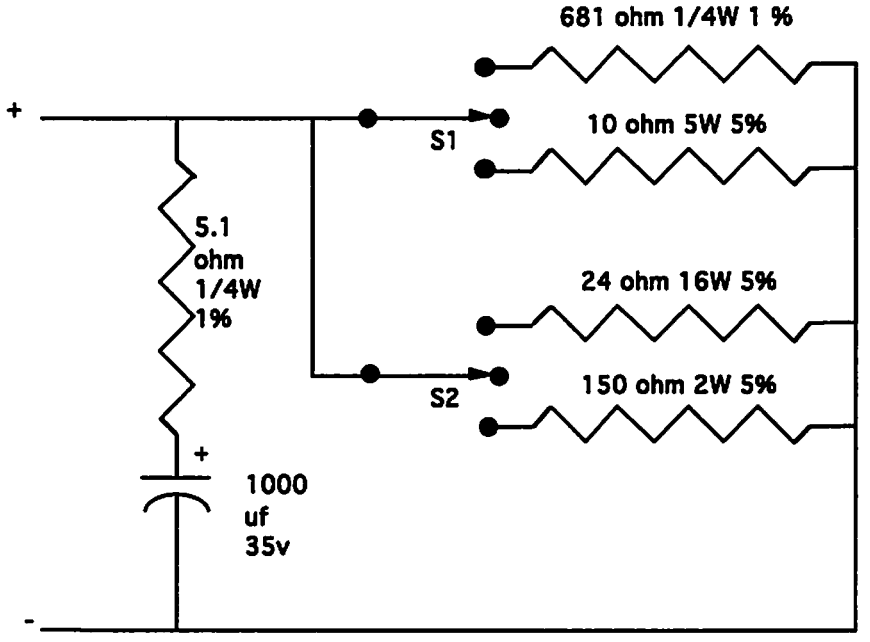


Figure 3-8. Battery Charger Test Circuit

Perform the following procedure:

1. Disconnect the battery and connect the voltmeter to the battery connector leads from the Monitor. Connect the positive voltmeter lead to the red battery lead; negative voltmeter lead to the black battery lead.

2. Attach a 681 ohm load and a 5.1 ohm, 1000 µf combination in parallel with the voltmeter as shown in Figure 3-8.

3. Ensure that the AC power supply is connected to an appropriate outlet.

4. Adjust R12 on the power supply PWA as shown in Figure 3-9 for +13.75 ±.05 Vdc.

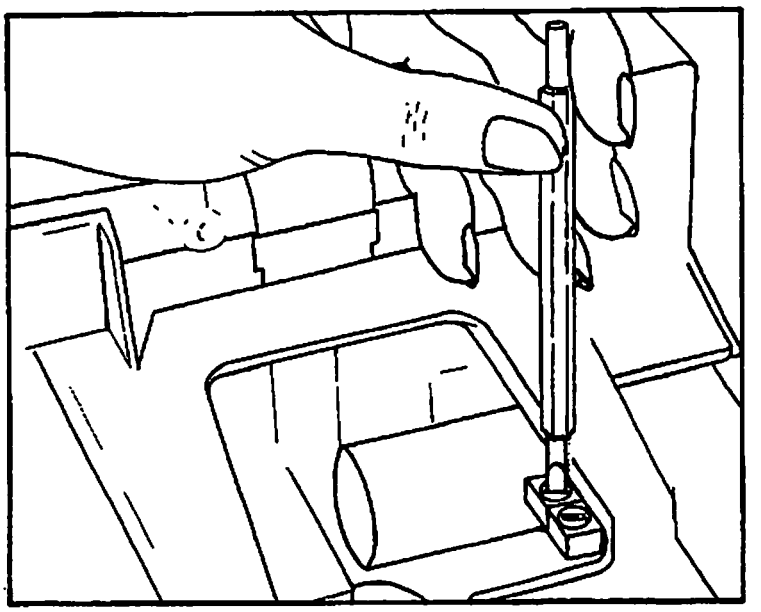


Figure 3-9 Battery Charger Float Voltage Adjustment

5. Test the battery charger circuit by applying various loads as shown in Table 3-4.

Table 3-4. Battery Charger Load Test

Load	Unit Power	Voltage
681 Ω	On	13.75 ±.05*
24 Ω	Off	14.6 ±.3
24 Ω	On	9.6 ±1.2
150 Ω	On	14.6 ±.3
10 Ω	Off	<6.75
10 Ω	On	4.0 ±.5

* Adjust R12 as shown in Figure 3-9.

3.5.3 Precision Reference Voltage Adjustment

The precision reference voltage supply is adjusted by R48 on the system processor PWA. Adjust the precision reference voltage supply as follows:

1. Using a long voltmeter probe, connect the positive lead to TP11 on the system processor PWA as shown in Figure 3-10.

2. Connect the negative lead of the meter to the outside connector JP19 on the bottom of the system processor PWA.

3. Ensure that a charged battery is installed in the Monitor or that the AC power supply is connected.

4. Press the **ON** switch on the front of the Monitor.

5. The voltmeter should read +4.50 ±0.01Vdc. Adjust R48 with a tuning wand as shown in Figure 3-10 to obtain this reading.

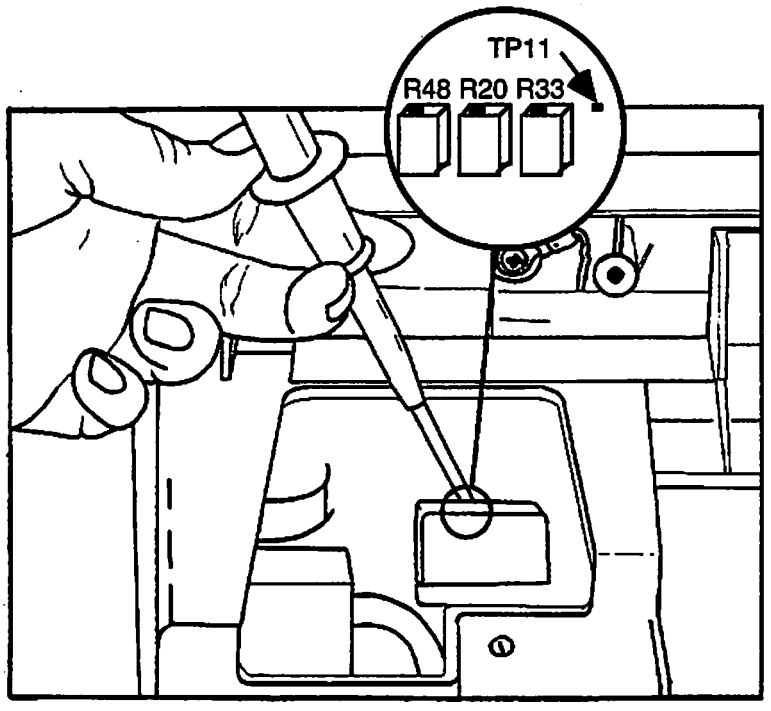


Figure 3-10. Precision Reference Voltage Test Point and Adjustment

3.5.4 Pressure Calibration Adjustment

If the Pressure Calibration Check reveals that a pressure calibration adjustment is necessary, first perform the Precision Reference Voltage Adjustment as outlined in paragraph 3.5.3. The pressure calibration adjustment involves a reiterative adjustment of the transducer zero adjustment (R33 on the system processor PWA) and the transducer scale adjustment (R20 on the system processor PWA) and utilizes the pressure displays on the front panel with the Monitor in Calibration Mode 2.

Perform the following procedure:

1. Obtain the calibration kit (Part Number 320-246).
2. Connect a manometer to the Monitor using the parts supplied with the calibration kit as shown in Figure 3-4. Open the pressure release valve on the inflation bulb.
3. Plug the Monitor into the specified line power outlet.
4. Press and hold the **SET** button while pressing the power **ON** button. The unit turns on, and enters Calibration Mode 1.
5. Press **SET** to enter calibration mode 2.
6. The **PULSE** display shows the zero offset value in A-to-D units. This should be in the range of -18 to -32 (optimally -25 at room temperature). The **PULSE** display is updated only after an auto-zero is performed so after each adjustment to R33 the Monitor must be looped through the calibration modes and returned to calibration mode 2 to show the new setting. Adjust R33 as shown in FO-3A for an offset reading of -23. Clockwise decreases offset, counterclockwise increases offset.
7. Close the pressure release valve on the manometer inflation bulb and slowly pump up the pressure to 200 mmHg as indicated by the mercury manometer.
8. Adjust R20 on the system processor PWA as shown in FO-3A until the **MAP** display (**TEMPERATURE** display on the Model 9340 Monitor) indicates 200.

9. Press SET until Calibration Mode 2 is re-entered and repeat steps 6 through 8.

3.5.5 Overpressure Switch Adjustment

The standard pneumatics PWA contains an overpressure switch that is set at the factory to trigger an 800 system alarm whenever cuff pressure reaches 300 ±30 mmHg.

NOTE

Refer to paragraph 3.5.6 for the overpressure adjustment procedure for French Models 9303 and 9343 Monitors.

If it is determined during the Overpressure Safety Check (paragraph 3.4.5) that the overpressure switch is not functioning properly, perform the following adjustment procedure:

1. Obtain the calibration kit (Part Number 320-246).
2. Connect a manometer to the Monitor using the parts supplied with the calibration kit as shown in Figure 3-4. Open the pressure release valve on the inflation bulb.
3. Plug the Monitor into the specified line power outlet.
4. Press and hold the **SET** button while pressing the power **ON** button. The unit turns on, and enters Calibration Mode 1.
5. Close the pressure release valve on the manometer inflation bulb and *slowly* pump up the pressure while observing the manometer and note at what pressure the 800 alarm is generated.
6. Locate the adjustment screw in the overpressure switch as shown in Figure 3-11 and adjust the screw to change the pressure alarm state so that the overpressure switch trips at approximately 300 mmHg.

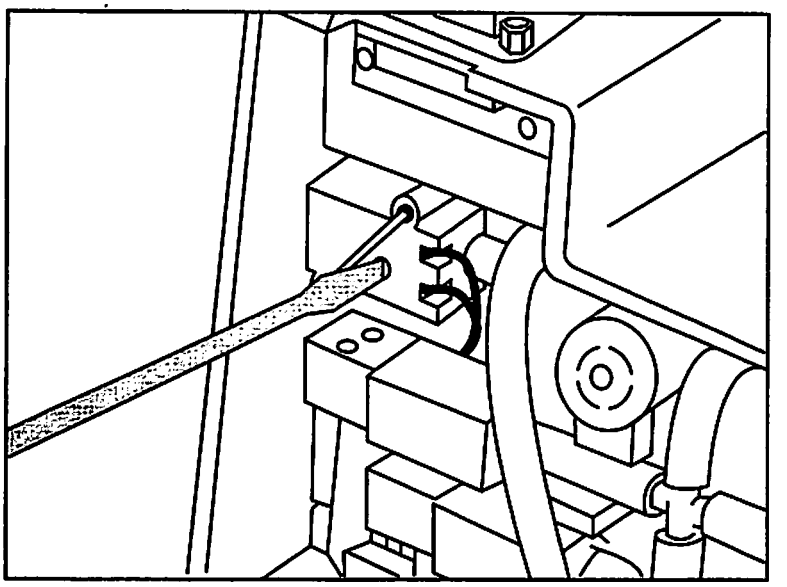


Figure 3-11. Overpressure Switch Adjustment

3.5.6 Overpressure PWA Adjustment

The Model 9303 and 9343 Monitors contain a pneumatics PWA that uses an overpressure PWA in place of an overpressure switch. The overpressure PWA provides a dual set point overpressure switch. Pressure from the CUFF port is applied to a pressure sensor on the overpressure board. Pressure is set at the factory to trigger an 800 system alarm whenever cuff pressure exceeds 300 mmHg in adult mode and about 158 mmHg in neonate mode. If it is determined during the Overpressure Safety Check (paragraph 3.4.5) that the overpressure PWA is not functioning properly, perform the following adjustment procedure:

1. Obtain the calibration kit (Part Number 320-246).
2. Connect a manometer to the Monitor using the parts supplied with the calibration kit as shown in Figure 3-4. Open the pressure release valve on the inflation bulb.
3. Plug the Monitor into the specified line power outlet.

4. Press and hold the **SET** button while pressing the power **ON** button. When the unit turns on, enter Calibration Mode 2.

5. Make sure that the Monitor is in the adult mode by pressing the **LOW** button three times. Disregard any error indications, and continue with step 6.

6. Close the pressure release valve on the manometer inflation bulb and *slowly* pump up the pressure while observing the manometer and note at what pressure the 800 alarm is generated. The pressure indicated on the manometer should be between 280 and 320 mmHg.

7. Release the pressure, clear the 800 alarm, and re-enter Calibration Mode 2.

8. Press the **HIGH** switch three times. This places the Monitor in the neonate mode.

9. Repeat step 6 for a manometer pressure between 152 and 164 mmHg.

10. If the pressure is out of range for either mode, adjust the overpressure points (see Figure 3-12) using adult control R10 and neonate control R11 on the overpressure PWA. R10 is located at the upper left and R11 is located at the lower right.

11. Turn either adjustment clockwise to trip the switch at a higher pressure or counterclockwise to trip the switch at a lower pressure. Repeat steps 5 through 10 until the overpressure points are within the respective ranges.

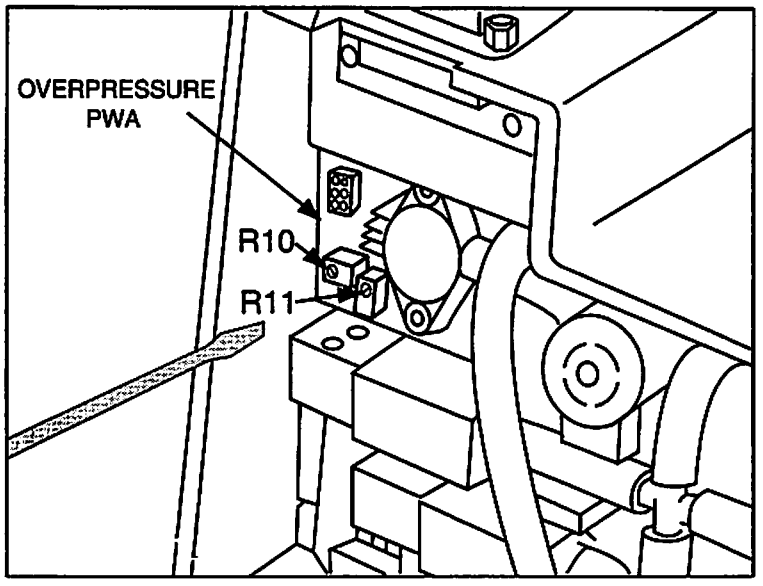


Figure 3-12. Overpressure PWA Adjustments

3.5.7 Temperature Circuit Adjustments

Calibration of the Model 9340 Monitor temperature detection circuits requires adjustments be made to R37 and R42 located on the foil side of the display PWA as shown in Figure 3-13.

Perform the following steps:

1. Obtain a calibration laboratory standard resistor of 6090 ±7Ω.
2. Connect the resistor to the front panel **PROBE** connector between pins 3 and 6.
3. Turn the on the Monitor and enter Calibration Mode 5 (refer to section 3.3).
4. Adjust R37 on the foil side of the display PWA as shown in Figure 3-13 for a **TEMPERATURE** front panel reading of 956 ±1.
5. Select Channel 1 to the temperature converter by pressing the front panel **HIGH LIMIT** switch twice.

6. Adjust R42 on the foil side of the display PWA as shown in Figure 3-13 for a front panel **TEMPERATURE** display reading of 948.

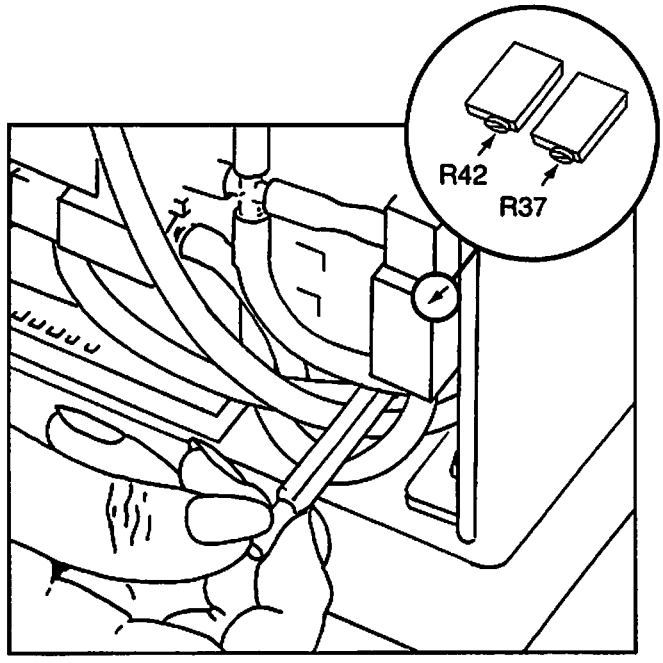


Figure 3-13. Locations of R37 and R42

7. Cycle the unit off/on. Press **START** and wait 60 seconds for the determination to process. If the reading in the **TEMPERATURE** window is 98.6, temperature calibration is complete.

8. If the reading is not 98.6, enter Calibration Mode 5 and repeat steps 5, 6, and 7 until the reading is 98.6.

3.6 JUMPER OPTIONS

Jumper options are accessible at the bottom of the system processor PWA as shown in Figure 3-14. These are identified on the PWA as JP12, JP19, JP20, JP21 and JP22. The jumpers are inserted by placing a jumper-header (part number 607-297) over the staked pins. JP12, JP19, and JP22 are not used.

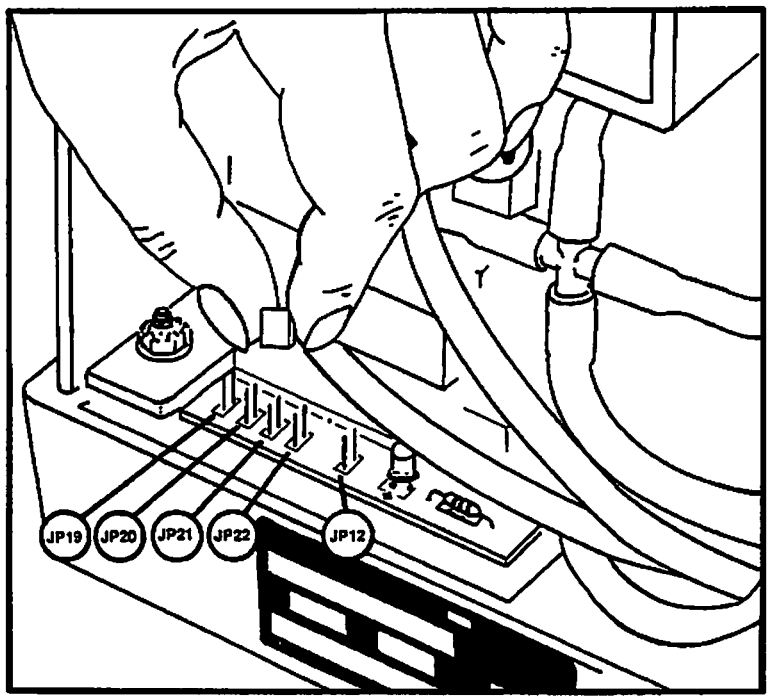


Figure 3-14. System Processor PWA Jumper Options

On the Model 9302 Monitor, JP20 is used to select continuously displayed cuff pressure in the **DIASTOLIC** display. JP20 is not used on the Model 9300, 9301, or 9303 Monitors.

On the Model 9340 and 9341 Monitors, JP20 selects the 12-minute predictive temperature mode. Default is three minutes without this jumper. JP21 enables the **°C** default when installed. The default is **°F** without JP21. JP20 and JP21 are not used on the Model 9342 and 9343 Monitors.

3.7 TROUBLESHOOTING AND FAULT ISOLATION

The following paragraphs contain troubleshooting information for faults related to system problems. Refer to DINAMAP *XL* Vital Signs Monitor Operation Manual 776-600 for faults related to operation in the clinical environment.

3.7.1 General Faults

Table 3-5 lists general faults and possible causes for failures in the 9300 Series Monitors.

Table 3-5. General Faults

DESCRIPTION	PROBABLE CAUSE
Unit will not operate on AC. **MAINS AC** LED *is not* lit with AC power cord attached	• AC power cord • Primary fuses • Transformer • CR6 bridge rectifier on power supply shorted
Unit will not operate on AC. **MAINS AC** LED *is* lit with AC power cord attached	• On/Off button on the front panel • U4, U5, Q12, or CR7 on power supply
Unit is blowing primary fuses	• Wrong fuse rating • Shorted varistor on transformer assembly • Shorted primary or secondary windings in the transformer • Internal power supply short • System processor, display, or pneumatic PWA shorting one of the supply voltages (+5 or +8)
Battery will not hold a charge	• Battery too old (check date) • Corroded battery terminals • Blown battery fuse • U3, Q2, Q6, or Q11 on power supply

3.7.2 Blood Pressure System (800 Series) Alarms

When the Monitor is unable to make a blood pressure determination because of a fault external to the system processor, it blanks all vital signs displays, flashes an 800 series alarm code in the **PULSE** display, and sounds the audio alarm in an ascending fashion just as for the vital signs limit alarms. Some alarms can be silenced by pressing the **SILENCE** switch, some cannot. All can be canceled. Table 3-6 lists 800 series alarms for faults relating to blood pressure.

Table 3-6. 800 Series Alarms

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
800	EXCESS PRESSURE	Pneumatics system pressure is greater than: • 300 ±20 mmHg in adult mode, or • 235 ±10 mmHg in neonatal mode (158±10 mmHg for French pneumatics system), or • 20 mmHg for 20 seconds during wait time, or • 250 mmHg for 20 seconds during a determination	• Kinked or pinched hose • Failure of one of the pneumatic valves (MT1, MT2, or MT3) on the pneumatics PWA • Overpressure switch (S1) or overpressure PWA defective or misadjusted • Overpressure signal (OP-1) bad or missing from the pneumatics PWA • Overpressure signal control latch (U3) on the pneumatics PWA (alarm code appears right after powering up the monitor; even before starting an inflation) • Defective pump, drawing excessive current from the drive circuit (failures appear after starting an inflation) • Defective pneumatic reset control circuit (U21, U22)
		Excess pneumatics system pressure at power up	• If unit was dropped and J3 was damaged, replace J3, U2 and U3 on pneumatics PWA • If unit was not dropped, over pressure switch (S1) or overpressure PWA is out of adjustment or defective
		Excess pneumatics system pressure when pushing **START** button	• Pinched hose or internal pneumatic blockage • pneumatic valves (MT1, MT2, or MT3) on the pneumatics PWA
		Excess pneumatics system pressure intermittently	• Overpressure switch (S1) or overpressure PWA defective

Table 3-6. 800 Series Alarms (Continued)

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
833	CUFF INFLATION TIME OVER 40 SECONDS	Pump cannot reach the target pressure within 40 seconds	• Leak in hoses or hose connector • Internal pneumatics system leak or failure of one of the pneumatic valves (MT1, MT2, or MT3) • Digital control signals from U2 on the system processor PWA • Perforated pump diaphragm • Pump defective or not running at all; may be due to an electrical failure in the pump drive circuit (U1, U2, Q2) on the pneumatics PWA • System processor PWA not activating the pump control signal (U2)
		Pump *is* running	• Cuff connectors • Internal hose leak • Bulkheads • Pneumatic filters or valves
		Pump *is not* running	• U1, U2, or Q2 on pneumatics PWA • No Vp signal on pneumatics PWA • **START** key on front panel • Defective pump if voltage present at J2-1 and J2--2 on pneumatics PWA • J3 on pneumatics PWA damaged
844	DETERMINATION TIME OVER 120 SECONDS	Determination not completed within 120 seconds (200 seconds on Model 8300)	• Leak in hose or hose connector • Internal pneumatics system leak or failure of one of the pneumatic valves (MT1, MT2, or MT3) • Digital control signals from U2 on the system processor PWA • Electrical noise occurring in the analog pressure transducer (TX1) circuit on the system processor (may be caused by an unstable -6 volt power supply, unstable or misadjusted precision reference voltage output, transducer voltage or excitation source, or operational amplifiers and filter circuits in the chain (Q1, Q2, U14, U18, U19, U20)
855	AT ONE PRESSURE LEVEL OVER 60 SECONDS	Pressure stays at one level, (no matched pulses found or constant despite efforts to step down the pressure)	• Kinked or pinched hose • Internal pneumatic blockage or valve failure (MT1, MT2, MT3) • Digital control signals from U2 on the system processor • Failure of the deflate valve drive logic circuit on the pneumatics PWA (U2, Q1) • Electrical noise occurring in the pressure transducer amplifier circuit (Q1, Q2, U14, U15, U16, U20) on the system processor • Electrical noise from the pressure transducer (TX1). (Very rare - should be considered only as a last resort)

Table 3-6. 800 Series Alarms (Continued)

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
888	NORMAL POWER UP INDICATION OR POWER INTERRUPTION	Power interruption after initialization NOTE Normal alarm when power is first applied	• Power supply (+5, +8, or -6 Vdc) or battery
899	WEAK PULSE OR INSUFFICIENT SIGNAL	Signal too weak to make a determination	• AUTO ZERO valve (MT1) on pneumatics PWA • Insufficient pressure on transducer (TX1) on the system processor PWA • Electrical noise occurring in the pressure transducer amplifier circuit (Q1, Q2, U14, U15, U16, U20, U8) on the system processor

3.7.3 Temperature System (E00 Series) Alert Codes

When the Monitor is unable to make a temperature determination because of a fault external to the system processor, it flashes an E00 series alert code in the **TEMPERATURE** display. Table 3-7 lists E00 series alarms for temperature system faults (Model 9340 Monitor only).

Table 3-7. E00 Series Alarms

ALARM	NAME	DESCRIPTION	PROBABLE CAUSES
E33	PROBE PROBLEM	Probe assembly not connected or continuity broken in the probe or probe connector circuits (NORMAL mode only)	• Defective electrical connection in cable harness or at plug/socket contacts. • Defective temperature probe

3.7.4 Internal Error (900 Series) Alarms

Internal diagnostics are continually run by the Monitor to detect certain hardware faults before they have a chance to affect accuracy or efficacy. In addition there are software traps programmed into the Monitor to detect any software errors. The occurrence of any hardware or software error causes the Monitor to flash a 900 series alarm code in the **PULSE** display and sound a continuous, high-level audio alarm which cannot be silenced or canceled. The software errors are undefined in this document since they cannot be repaired in the field and should be referred to Customer Service for correction. Table 3-8 lists 900 series alarms for internal diagnostics failures.

Table 3-8. 900 Series Alarms

ALARM	NAME	DESCRIPTION	PROBABLE CAUSES
901	TIME BASE COMPARISON ERROR	Frequency comparison of system processor clock and Failsafe Timer circuit clock is off by more than ±0.5 %	• A fail-safe timer circuit failure (U11, U12, crystal Y2) on the system processor • Microprocessor system clock timing error (U2, U1, crystal Y1, U9, C9) on the system processor
902	INTERNAL JUMPER ERROR	One or more jumpers are configured wrong for normal operation	• Calibration or test jumpers have been left in the unit after maintenance or test procedures have been performed • Refer to paragraph 3.6 for correct jumper options connection
911	PLUS 5 VDC SUPPLY OUT-OF-LIMITS	Indicates that the +5 Vdc supply is out of tolerance	• Incorrect AC line voltage • Power supply module (U1, U2, Q1, L2, CR3) • Misadjustment of the +5 volt logic supply circuit (R13) • Defective electrical connections at plug/socket contacts (power supply, system processor, pneumatic, or display) • Excessive loading of power supply by other electrically failed components or wiring (could be located on any of the system modules) • Defective A/D Converter (U7) on the system processor

Table 3-8. 900 Series Alarms (Continued)

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
912	PLUS 8 VDC SUPPLY OUT-OF-LIMITS	Indicates that the +8 Vdc supply is out of tolerance.	• Incorrect AC line voltage • Power supply module defect (U1, U2, Q3, L3, CR2) • Misadjustment of the 5 volt logic supply circuit (R13) (this affects the 8 volt supply) • Defective electrical connections at plug/socket contacts (power supply, system processor, pneumatics, or display) • Excessive loading of power supply by other electrically failed components or wiring (could be located on any of the system modules) • Defective A/D Converter (U7) on the system processor
913	MINUS 6 VDC SUPPLY OUT-OF-LIMITS	Indicates that the -6 Vdc supply is out of tolerance.	• Excessive loading of power supply by other components in the analog circuit (U14, U15, U20, U16) • Defective component on the -6 volt power supply circuit (U18, Q3, Q4, C24, C25) • Defective A/D Converter (U7) on the system processor
922	PRESSURE CHANNEL ERROR BEFORE AUTO-ZERO	Indicates that the uncorrected transducer output is outside the range of 1 to 50 A-to-D units	• Gross miscalibration of pressure transducer amplifier gain (R20, R33) on the system processor • Precision reference voltage out of tolerance (R48) on system processor • Out-of-tolerance components in the transducer amplifier circuit; missing transducer excitation voltage (Q1, Q2, U20, U14) on the system processor • -6 volt supply output out of tolerance on power supply • Defective A/D Converter (U7) on the system processor

Table 3-8. 900 Series Alarms (Continued)

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
923	PRESSURE CHANNEL ERROR AFTER AUTO-ZERO	Indicates that the auto zero operation failed to establish a zero offset	• Misadjustment of PT Zero offset (R33) on the system processor • Precision reference voltage out of tolerance (R48) on the system processor • Analog circuit (U14, U20, U17, U7, U8) fails to perform the auto-zero operation on the system processor
924	MINUS 50 OFFSET PRESSURE CHANNEL ERROR	Indicates that the internal offset for high pressure levels is outside the range of 49 to 53 A/D units	• Precision reference voltage out of tolerance (R48) on the system processor • Analog circuit (U8, U14, U17) fails to complete "DASH50" offset operation on the system processor • Unstable QCLK signal on system processor (U1) • Digital output latch failure (U2, U8) on the system processor
925	OSCILLATION CHANNEL TEST FAILURE	Indicates that the unit has failed the oscillation channel (FPT) test	• Oscillation channel amplifier or filter circuit failure (U15, U16, U17, CR6, CR7, C22, C23) on the system processor • Unstable "QCLOCK" signal; digital output latch failure (U2, U8)
926	AUTO-ZERO VERIFICATION ERROR	This error code indicates that the unit has failed the auto-zero verification test at the end of a determination	• Noisy FPT amplifier output (U15) on the system processor • Defective or partially clogged deflate and/or dump valve (MT2, MT3) on the pneumatics PWA • Dirty or clogged air filters • Pinched tubing in the pneumatics harness
927	TEMPERATURE CALIBRATION ERROR (54°)	Model 9340 Monitor temperature calibration test failure performed periodically by the software (temperature channel 0 failed to give a reading of 54° F	• Defective component on temperature calibration channel 0 (R44, R45, R46, R47, U17) on the display PWA • Defective voltage-to-frequency converter (U16) on the display PWA • Gross misadjustment of reference voltage (R37) or temperature precision reference (R42) on the display PWA
928	TEMPERATURE CALIBRATION ERROR (98°)	Model 9340 Monitor temperature calibration test failure performed periodically by the software (temperature channel 0 failed to give a reading of 98° F	• Defective component on temperature calibration channel 1 (R44, R45, R46, R47, U17) on the display PWA • Defective voltage-to-frequency converter (U16) on the display PWA • Gross misadjustment of reference voltage (R37) or temperature precision reference (R42) on the display PWA

Table 3-8. 900 Series Alarms (Continued)

ALARM	NAME	DESCRIPTION	PROBABLE CAUSE
929	TEMPERATURE CALIBRATION ERROR (108°)	Model 9340 Monitor temperature calibration test failure performed periodically by the software (temperature channel 0 failed to give a reading of 108° F	• Defective component on temperature calibration channel 2 (R63, R64, R65, R66, U17) on the display PWA • Defective voltage-to-frequency converter (U16) on the display PWA
930	TEMPERATURE PROBE TYPE CODE ERROR	Problem with the probe type code (oral/rectal) circuitry in the probe or the probe connector	• Defective temperature probe • Defective electrical connections in cable harness wiring or at plug/socket contacts
966	RAM TEST FAILURE	Periodic RAM test routine failure	• Defective RAM (U5) on the system processor
977	ROM CHECKSUM ERROR	Periodic ROM test routine failure	• Defective ROM (U4) on the system processor
987	(FIRQ) OVERRUN	Software overrun	• Possible microprocessor VLSI chip malfunction

SECTION 5. MODEL 9340 TOP ASSEMBLY

5.1 INTRODUCTION

This section contains component information about Model 9340 top assembly 354-464 and the variations listed below:

Model	Version	Top Assembly
9340	Domestic	354-464
9341	British	354-465
9342	German	354-466
9343	French	354-467

This section also contains component information about sub-top assembly 351-076 and the variations listed below:

Version	Sub-top Assembly
Domestic	351-076
English	351-077
German	351-078
French	351-079

NOTE

Refer to Section 4 for component location diagrams.

5.2
PARTS LIST
TOP ASSEMBLY
354-464

ITEM	DESCRIPTION	PART NUMBER
1	SUB TOP ASSY, 9340	351-076
	SUB TOP ASSY, 9341	351-077
	SUB TOP ASSY, 9342	351-078
	SUB TOP ASSY, 9343	351-079
3	CASE, MOLDED 9300/9320/9340 SERIES	759-314
9	SCREW, 6-32X1/2 PNH PHH SST	719-439
11	KNOB, POLE CLAMP	759-183
12	SCREW,10-32X1-1/8 FLT PHH BLK	719-257
19	BUMPER BLACK .5 SQUARE, .12 HIGH	732-161
26	CONNECTOR, SHUNT, 2 POSITION, JMP20	607-297

5.3
PARTS LIST
SUB-TOP ASSEMBLY
351-076

ITEM	DESCRIPTION	PART NUMBER
1	BATTERY ASSY	320-378
2	BEZEL ASSY 9340, ENGLISH	332-220
	BEZEL ASSY 9341, GERMAN	332-221
	BEZEL ASSY 9342, FRENCH	332-222
3	CLIP, PLASTIC SELF ADHESIVE	752-192
4	BRACKET, PUMP MTG, 8100	704-682
5	PWA, POWER SUPPLY	315-503
6	FRAME, MOLDED	759-176
7	CONNECTOR, SHUNT, 2 POSITION	‡607-297
8	PNEUMATICS PWA	315-316
	PNEUMATICS PWA	ƒ315-480
9	TRANSFORMER ASSY 120V	√320-432
	TRANSFORMER ASSY 230V	†320-433
10	CONN ASSY. AC POWER	320-665
11	ASSEMBLY CLAMP	320-400
12	SCREW, 6-32X3/8 PNH PHH SST	719-114
13	SCREW,L.H.POLE CLAMP	704-646
15	SCREW, 6-32X1/4 PNH PHH SST	719-103
16	JACK SCREW 3/16 HEX, 5/16 THREAD LGTH	722-210
17	T-NUT POLE CLAMP	759-218
18	WASHER, FLAT #6 SST	723-103
19	SCREW, 8-32X5/8 PNH PHH SST	719-199
20	WASHER, FLAT #8 SST	723-104
21	SCREW, 6-32X5/16 FLT PHH SST	719-147
22	CABLE ASSEMBLY,BATTERY	316-341
23	THRUST PLATE	704-647
25	FUSE 1/2AMP 250V FAST ACTING	√628-109
	FUSE 1/4AMP 250V FAST ACTING	†628-132
26	FUSEHOLDER, 3AG, GRAY	√617-110
	FUSEHOLDER, METRIC, BLACK	†617-109

‡ Denotes a part only for German unit
ƒ Denotes a part only for French unit
† Denotes a part only for British, French, and German units
√ Denotes a part only for Domestic unit.

5.3
PARTS LIST
SUB-TOP ASSEMBLY
351-076 (CONT)

ITEM	DESCRIPTION	PART NUMBER
27	WASHER, .150 ID .312 OD, .062THK	725-103
33	BATTERY RETENTION PAD (HOOK)	750-156
34	BATTERY COMPARTMENT FLOOR PAD	750-157
36	POWER SUPPLY BOARD SHOCK PAD	750-159
41	WASHER,FLAT SMALL PATTERN #6	723-107
42	CONTACT STRIP, ESD SHIELDING	608-189
43	WASHER,LOCK,FL-INT TOOTH SST#6	724-107
44	NUT,HEX #6 SST	715-108
45	WASHER,FLAT #4 SST	723-403
46	NUT,SELF-LOCKING,NYLON INSR #4	716-404
48	NUT,SELF-LOCKING,NYLON INSR #6	716-401
49	PUMP, AIR 12 VDC WITH WIRES	712-250
50	MUFFLER ASSY	320-397
51	GROMMET, ISOLATOR	732-144
54	FERRULE,THREADED,ISOLATOR	727-137
56	FOAM TAPE, DOUBLE STICKY	774-131
57	VALVE, AIR-CHECK	754-129
58	TUBING PHARMED	740-185
60	FASTENER, NUT J TYPE NO.6 SCREW	√716-133
61	CABLE ASSY, GND XMER/BEZEL	316-553
62	BUMPER BLACK 0.500 SQUARE	732-141

√ Denotes a part only for Domestic unit

SECTION 6. BEZEL ASSEMBLY 332-213

6.1 INTRODUCTION

This section contains component information about bezel assembly 332-213 and the versions listed below:

Part Number	Version
332-213	English
332-214	German
332-215	French

6.2 PRINCIPLES OF OPERATION

The front panel schematic diagram is illustrated in Figure 6-1.

The system processor continually strobes KEYROW0, KEYROW1, and KEYROW2. During this time KEYCOL0, KEYCOL1, KEYCOL2, and KEYCOL3 are continually polled to determine if a button is pressed. When a button is pressed, the processor responds and performs the command.

Pressing ON grounds ON-0 and turns the Monitor on; pressing OFF grounds OFF-0 and turns the Monitor off.

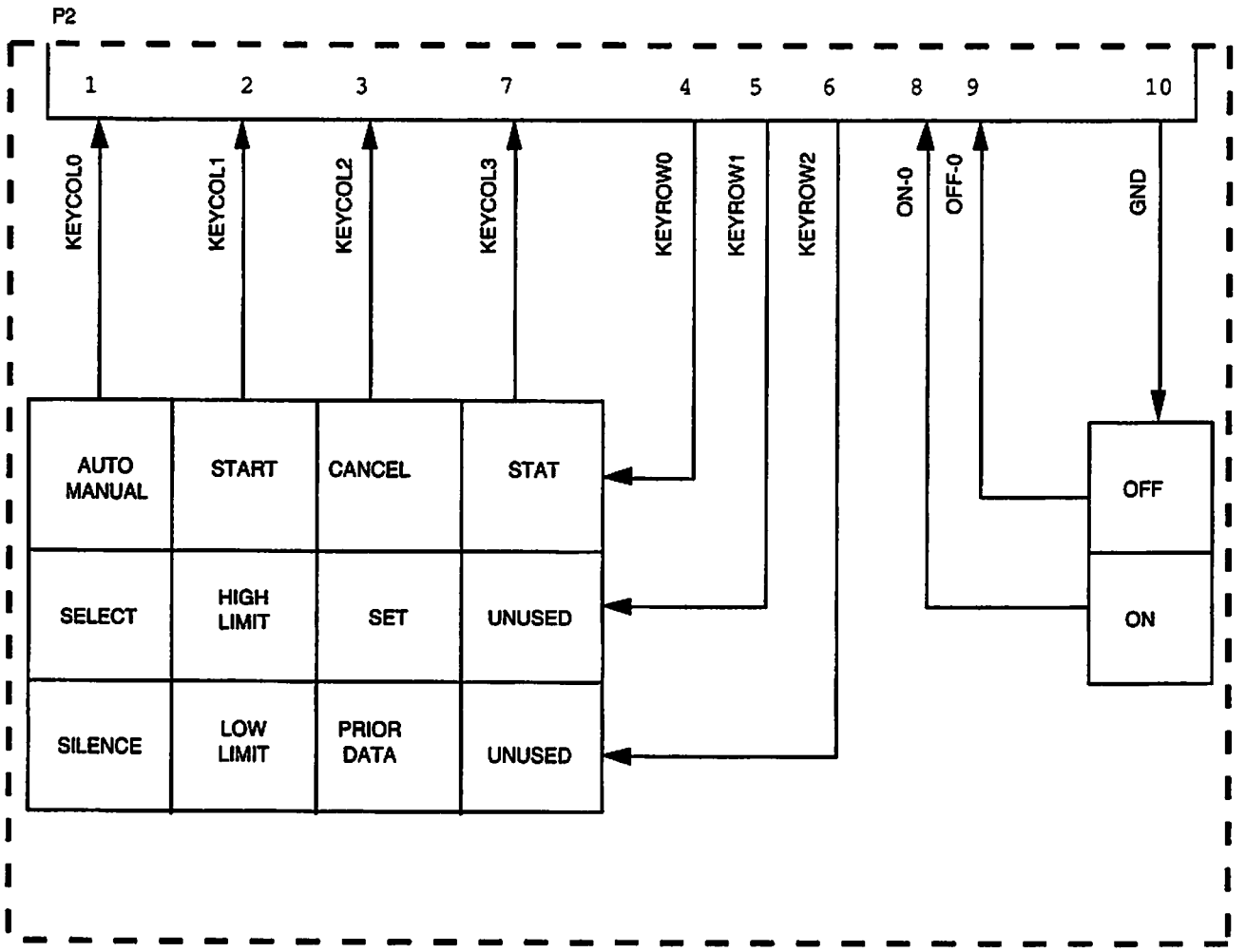
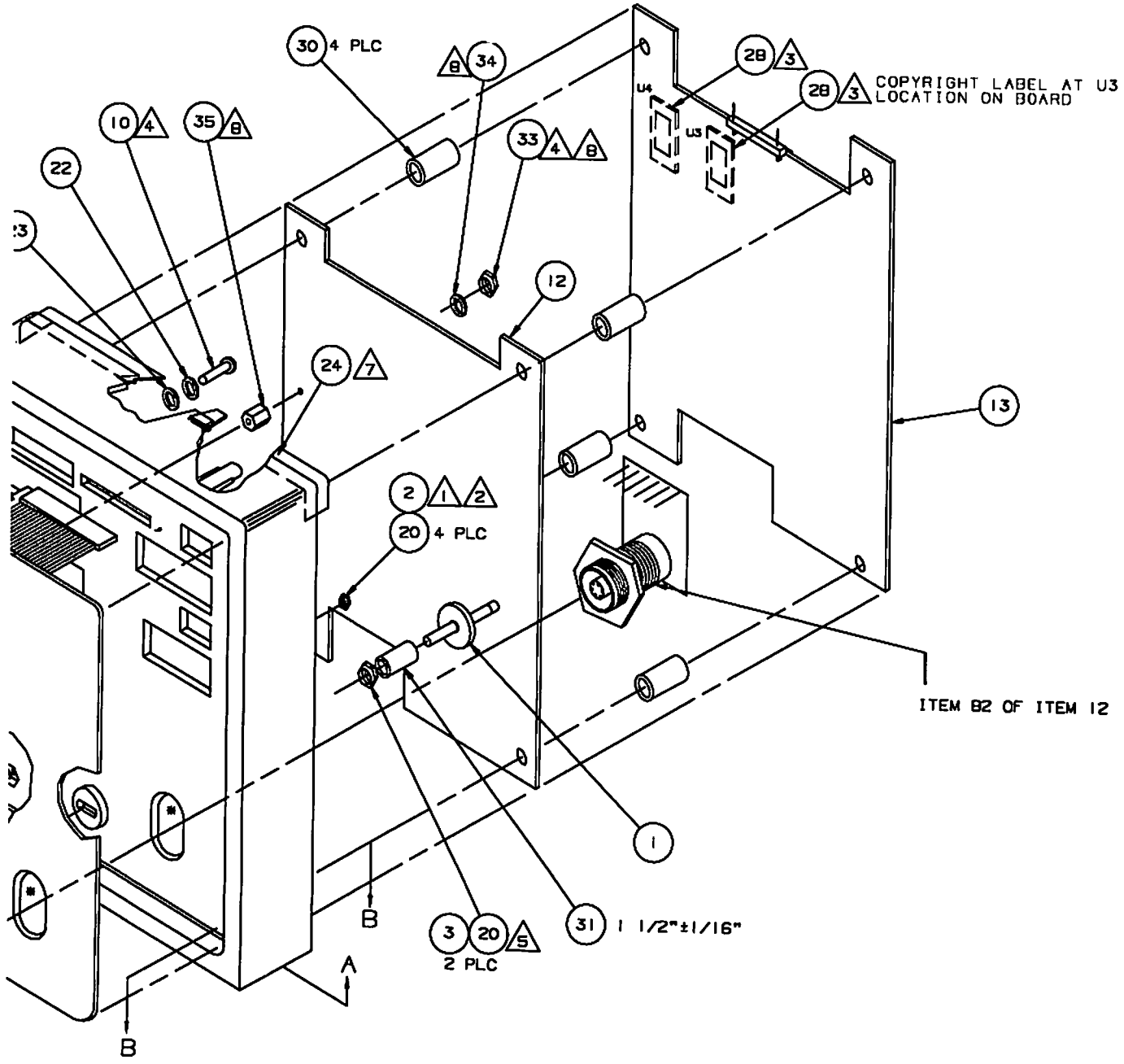


Figure 6-1. Model 9300 Monitor Front Panel Schematic Diagram

6.3
PARTS LIST
(Refer to Foldout FO-6A)

ITEM	DESCRIPTION	PART NUMBER
1	FILTER, 43 MICRON DISP .AIRINLINE	754-118
2	NUT,HEX SM PATT #6 SST	715-103
3	NUT,HEX SPECIAL 5/16-24 BRASS	715-117
4	SCREW, 6-32 X 1-1/2 HEX HEAD SST	719-266
5	E-RING RADIALLY ASSEMBLED	736-171
7	FRONT PANEL, ENGLISH 9300	701-398
	FRONT PANEL, GERMAN 9302	‡701-418
	FRONT PANEL, FRENCH 9303	*f*701-419
	BULKHEAD FITTING CUFF CONNECTOR	704-719
9	BEZEL, MOLDED 9300/9320/9340 SERIES	759-315
10	SCREW, 6-32X1/4 PNH PHH SST	719-103
12	PWA, DISPLAY 9300	315-438
13	PWA, CPU 9300 SERIES	§
22	WASHER, FLAT #6 SST	723-103
23	SPRINGWASHER,#6 SPRINGSTEEL	725-116
24	SPLASH SHIELD SEAM	759-198
28	SOFTWARE ASSY, 9300 SERIES	√
30	SPACER,NYLON .510 OD X.582 THK X.150 ID	735-250
	CABLE ASSY, GND XMER/BEZEL	316-553
	BUMPER BLACK 0.500 SQUARE	732-141

√ Contact Customer Support for part number
§ A complete replacement CPU Board with software is available from Customer Support
f Denotes a part only for French unit
‡ Denotes a part only for German unit



FO-6A. Bezel Assy 332-213

SECTION 7. BEZEL ASSEMBLY 332-220

7.1 INTRODUCTION

This section contains component information about bezel assembly 332-220 and the versions listed below:

Part Number	Version
332-220	English
332-221	German
332-222	French

NOTE

Refer to Section 6 for component location diagrams.

7.2 PRINCIPLES OF OPERATION

The front panel schematic diagram is illustrated in Figure 7-1.

The system processor continually strobes KEYROW0, KEYROW1, and KEYROW2. During this time KEYCOL0, KEYCOL1, KEYCOL2, and KEYCOL3 are continually polled to determine if a button is pressed. When a button is pressed, the processor responds and performs the command.

Pressing ON grounds ON-0 and turns the Monitor on; pressing OFF grounds OFF-0 and turns the Monitor off.

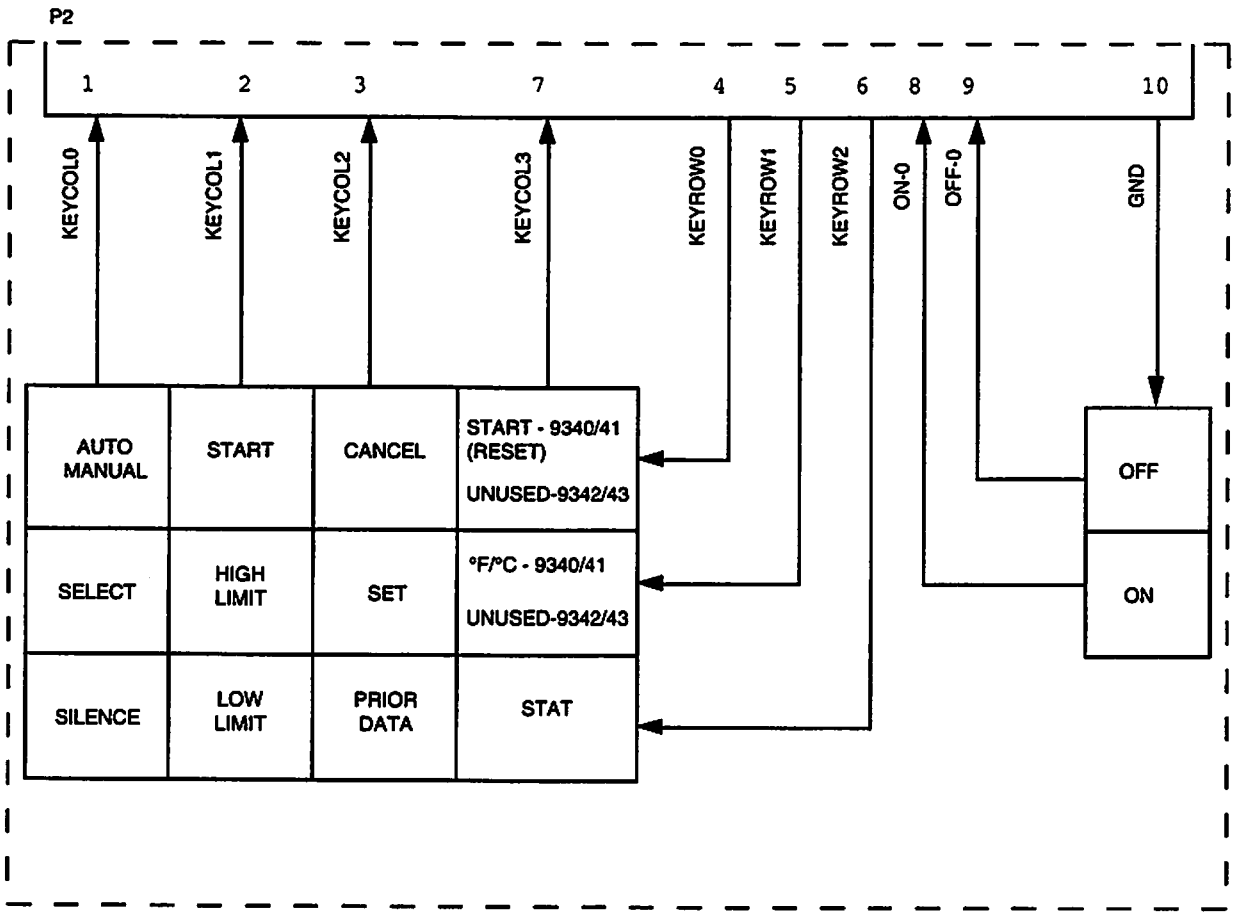


Figure 7-1. Model 9340 Monitor Front Panel Schematic Diagram

7.3
PARTS LIST

ITEM	DESCRIPTION	PART NUMBER
1	FILTER, 43 MICRON DISP .AIRINLINE	754-118
2	NUT,HEX SM PATT #6 SST	715-103
3	NUT,HEX SPECIAL 5/16-24 BRASS	715-117
4	SCREW, 6-32 X 1-1/2 HEX HEAD SST	719-266
5	E-RING RADIALLY ASSEMBLED	736-171
7	FRONT PANEL, ENGLISH 9340	701-399
	FRONT PANEL, GERMAN 9342	‡701-421
	FRONT PANEL, FRENCH 9343	ƒ701-422
8	BULKHEAD FITTING CUFF CONNECTOR	704-719
9	BEZEL, MOLDED 9300/9320/9340 SERIES	759-315
10	SCREW, 6-32X1/4 PNH PHH SST	719-103
12	PWA, DISPLAY 9340	315-439
	PWA, DISPLAY 9342/9343	†315-472
13	PWA, CPU 9300 SERIES	§
22	WASHER, FLAT #6 SST	723-103
23	SPRINGWASHER,#6 SPRINGSTEEL	725-116
24	SPLASH SHIELD SEAM	759-198
28	SOFTWARE ASSY, 9340/41	√
30	SPACER,NYLON .51O OD X.582 THK X.150 ID	735-250
32	SCREW,4-40X5/8 FLH PHH 100 DEG	719-410
33	NUT,HEX #4 SST	715-107
34	WASHER,LOCK SPLIT #4 SST	724-101
35	STANDOFF, HEX 4-40 X .25 IN SST	735-253

ƒ Denotes a part only for French unit
† Denotes a part only for French and German units
√ Contact Customer Support for part number
§ A complete replacement CPU Board with software is available from Customer Support

SECTION 8. DISPLAY PWA 315-438

8.1 INTRODUCTION

This section contains component information about display PWA 315-438.

8.2 PRINCIPLES OF OPERATION

The display PWA circuits are shown on schematic diagram SC315-438, located at the end of this section.

8.2.1 Seven-segment Displays

The seven-segment displays are shown on sheet 1 of the schematic diagram. These are grouped and identified as CYCLE, MAP, SYSTOLIC, PULSE and DIASTOLIC. Each digit display is a common-cathode array of seven segments and a decimal point. The seven segments, plus decimal point, are driven by 2907 PNP transistor packs U2 and U3, powered by the +5 supply, as shown on sheet 2 on of the schematic diagram. Base drive for these transistors is provided by LM324 linear op-amps U9 and U10 which are switched by the output of data latch U1. The common cathode connections for each digit display are individually pulled to ground by the outputs of address latch U7-U8 through NPN Darlington drivers U5-U6.

8.2.2 Discrete Point LED Displays

The discrete point LEDs are shown on sheets 1 & 2 of the schematic diagram. On sheet 2, MAINS AC LED DS39 lights when MAINSLED signal is asserted. Some LEDs shown on sheet 1 have their cathodes pulled to ground by U6-11 when the address latch bit DG14 is asserted. Others have their cathodes pulled to ground by U5-11 when DG15 is asserted. Each LED of this group shown on sheet 1 is driven by the +5 V supply through 2907 PNP transistor packs U2 and U3 selected by the state of data latch U1.

8.2.3 Display Data Transfer Timing

The display data transfers between the system processor and the display PWA are controlled by various NAND gates in U12, data latch U1, and address latch U4 as shown on sheets 1. When output data D0-D7 is written by the system processor to any address in the range of 0800H through 08FFH, the signal DSPLSEL-0 is asserted by the gate array on the system processor PWA. DSPLSEL-0 causes U12-3 to enable the latch trigger circuit at U12-5 so that the trailing edge of QCLK will latch data D0-D7 at U1-11 and address A0-A3 at U4-9.

Data latch U1 is a CMOS octal D-type flip-flop whose Q outputs LD0-LD7 are applied to the inverting inputs of linear op-amps U9-U10, as shown on sheet 2. When the output of any op-amp goes true (high), the associated driver transistor is turned on to apply +5V segment drive (or point LED drive) to the address-selected display.

Address latch U4 is a CMOS quad D-type flip-flop whose outputs are used to steer and gate the inputs of the octal address decoders, U7 and U8. Decoded address DG0 - DG15 is used to select the digit (or point LED group) by pulling the cathode to ground through its associated NPN Darlington driver (U5 - U6). The decoding of the latched address is delayed by approximately 10 microseconds after the leading edge of DSPLSEL-0 to prevent ghosting due to propagation delays. The decoding lasts until the leading edge of the next DSPLSEL-0 which occurs in response to the FIRQ (1200 Hz) interrupt to the system processor.

8.2.4 Scan Failure Protection and Ghosting

Scan failure protection and ghosting prevention is provided by dual CMOS multivibrator U13 shown on sheet 1. One half of U13 is configured to be a retriggerable one-shot at U13-6 with a period of 2 - 20 milliseconds (scan failure protection), and the other half is configured to be a 10 microsecond one-shot at U13-9 (ghosting prevention).

The output at U13-6 remains high as long as DSPLSEL-0 is asserted in response to the FIRQ interrupt. Should the microprocessor fail to address the display in response to the FIRQ interrupt or the gate array fail to generate the DSPLSEL-0 signal, U13-6 will go low when the one-shot times out (2 - 20 milliseconds) and disable the address decode circuits to prevent the last selected LED from being overdriven.

The output at U13-9 goes low for 10 microseconds after DSPLSEL-0 (DSPLSEL-0 is approximately 1 microsecond in length) to delay the decoding of the address by U12-11 and, thus, prevent ghosting due to propagation delays.

8.3
PARTS LIST
(Refer to Foldout FO-8A)

ITEM	DESCRIPTION	PART NUMBER
C1,4	CAP,CERAMIC,RAD,Z5U,50V,20%,0.1UF	602-235
C2	CAP,CER 56PF 50V MIN 10% AXIAL	602-144
C3,5,6,7	CAP, TANTALUM, 4.7UF, 20V MIN., 20%	603-199
DS1,32	DISPLAY, LED, 7-SEGMENT, RED	614-187
DS3,10, 16-19,30, 33,34	DISPLAY,LED,7 SEGMENT,RED	614-123
DS5,7,8	DISPLAY,LED,7 SEG,YELLOW	614-139
DS25,26, 28,38,39	LAMP, LED, GREEN ULTRA BRIGHT	614-178
DS27,40, 41,42	LAMP, LED, YELLOW HIGH INTENSITY	614-177
DS31	LAMP,LED YEL LG RECTANGULAR	614-124
J1	CONN., HEADER 26 POSN, W/SPACER	607-692
R1,4-6,12, 15-17,28	RES, CF 1/4 WATT, 5% 6.2K OHM	650-171
R2,3,8-11, 13,14	RES, CF 1/4 WATT, 5% 51K OHM	650-162
R7	RES, CF 1/4 WATT, 5% 62K OHM	650-172
R18-24,27	RES, MF, 1/8 WATT, 1%, 10 OHM	652-205
R25,26	RES, CF 1/4 WATT, 5% 100K OHM	650-104
U1	IC,74HCT374,CMOS OCTAL D FF	619-185
U2,3	IC,TPQ2907,QUAD PNP XSTR ARRAY	621-195
U4	IC,74HCT175,CMOS QUAD D FF	619-184
U5,6	IC,ULN2803 DARL NPN DRIVER OCT	620-149
U7,8	IC,74HC238,3 TO 8 DECODER	619-183
U9,10	IC, 324 LIN QUAD OP-AMP	621-141
U13	IC, 4538 CMOS MULTIVIBRATOR	619-123
	BUMPER BROWN 0.81 SQ 0.52HT	732-113
	SPACER, .3 IN., 7-SEGMENT LED	735-308

SECTION 9. DISPLAY PWA 315-439

9.1 INTRODUCTION

This section contains component information about display PWA 315-439 and the variation listed below:

Version	Sub-top Assembly
English	315-439
German and French	315-472

9.2 PRINCIPLES OF OPERATION

The display PWA circuits are shown on schematic diagram SC315-439, located at the end of this section.

9.2.1 Seven-segment Displays

The seven-segment displays are shown on sheet 2 of the schematic. These are grouped and identified as CYCLE, TEMPERATURE, SYSTOLIC, PULSE and DIASTOLIC. Each digit display is a common-cathode array of seven segments and a decimal point. The seven segments, plus decimal point, are driven by 2907 PNP transistor packs U2 and U3, powered by the +5 supply, as shown on sheet 1 of the schematic. Base drive for these transistors is provided by LM324 linear op-amps U9 and U10 which are switched by the output of data latch U1. The common cathode connections for each digit display are individually pulled to ground by the outputs of address latch U7-U8 through NPN Darlington drivers U5-U6.

9.2.2 Discrete Point LED Displays

The discrete point LEDs are shown on sheets 1 & 2 of the schematic. Those shown on sheet 2 have their cathodes pulled to ground by U6-12 when the address latch bit DG14 is asserted. DG11 from U6-15 controls STAT display DS37. Each LED of this group is driven by the +5 V supply through 2907 PNP transistor packs U2 and U3 selected by the state of data latch U1. The discrete LEDs shown on sheet 1 have their cathodes pulled to ground by the common collector outputs of data latch U14. The data latch is selected by the leading edge of the address decode, DG15, generated by U8 as shown on sheet 2.

9.2.3 Display Data Transfer Timing

The display data transfers between the CPU and the display PWA are controlled by various NAND gates in U12, data latch U1, and address latch U4 as shown on sheet 1. When output data D0-D7 is written by the CPU to any address in the range of 0800H through 0FFFH, the signal DSPLSEL-0 is asserted by the gate array on the CPU PWA. DSPLSEL-0 causes U12-3 to enable the latch trigger circuit at U12-5 so that the trailing edge of QCLK will latch data D0-D7 at U1-11 and address A0-A3 at U4-9.

Data latch U1 is a CMOS octal D-type flip-flop whose Q outputs LD0-LD7 are applied to the inverting inputs of linear op-amps U9-U10, as shown on sheet 2. When the output of any op-amp goes true (high), the associated driver transistor is turned on to apply +5V segment drive (or point LED drive) to the address-selected display.

Address latch U4 is a CMOS quad D-type flip-flop whose outputs are used to steer and gate the inputs of the octal address decoders, U7 and U8. Decoded address DG0 - DG15 is used to select the digit (or point LED group) by pulling the cathode to ground through its associated NPN Darlington driver (U5 - U6). The decoding of the latched address is delayed by approximately 10 microseconds after the leading edge of DSPLSEL-0 to prevent ghosting due to propagation delays. The decoding lasts until the leading edge of the next DSPLSEL-0 which occurs in response to the FIRQ (1200 Hz) interrupt to the CPU.

9.2.4 Scan Failure Protection and Ghosting

Scan failure protection and ghosting prevention is provided by a dual CMOS multivibrator, U13 shown on sheet 1. One half of U13 is configured to be a retriggerable one-shot at U13-6 with a period of 2 - 20 milliseconds (scan failure protection), and the other half is configured to be a 10 microsecond one-shot at U13-9 (ghosting prevention).

The output at U13-6 remains high as long as DSPLSEL-0 is asserted in response to the FIRQ interrupt. Should the microprocessor fail to address the display in response to the FIRQ interrupt or the gate array fail to generate the DSPLSEL-0 signal, U13-6 will go low when the one-shot times out (2 - 20 milliseconds) and disable the address decode circuits to prevent the last selected LED from being overdriven.

The output at U13-9 goes low for 10 microseconds after DSPLSEL-0 (DSPLSEL-0 is approximately 1 microsecond in length) to delay the decoding of the address by U12-11 and, thus, prevent ghosting due to propagation delays.

9.2.5 Temperature Conversion Circuits

The predictive temperature conversion circuits provide for temperature detection, digital conversion, auto-calibration and patient isolation. The temperature probe contains a thermistor which exhibits a precisely calibrated negative temperature coefficient of resistance. The thermistor is connected into a network comprising a precision resistance and voltage reference. The output of the network is a voltage that varies proportionally with temperature and linearly in the temperature range about normal body temperature. Nonlinearities outside this range are corrected in software.

The Monitor provides a tympanic probe digital interface for future use. The circuits would provide temperature detection and patient isolation.

9.2.5.1 Predictive Temperature Conversion

As shown on sheet 3 of the schematic, the voltage from the thermistor input network is digitized using voltage-to-frequency converter (VFC) U16. The output frequency of U16 is routed through opto-coupler U18 to J1-26. The software system measures this output frequency by counting transitions during a controlled gate interval which is proportional to the voltage output from the thermistor network at the input of U17. The specified accuracy requires greater stability in the A/D conversion than is provided by the long-term stability of the VFC. To meet the specification, a method of automatic calibration under software control is employed.

The input to the VFC is selected from among four sources by analog multiplexer U17. One input of which is the thermistor network. The other three inputs are reference voltages derived from the same excitation voltage source as the thermistor network.

The software can measure the known references and adjust the scale and offset of the measurements to cause the conversions to be correct. Thus, the system accuracy depends only on the stability and accuracy of the reference divider and thermistor input resistors. Variations in scale factor and offset due to temperature coefficients or long term drifts of the reference voltage or the VFC and associated circuitry can be canceled. This system also provides a self test capability and a means of detecting an oral or rectal temperature probe type.

The predictive temperature conversion circuits are shown at the bottom of sheet 3 of schematic diagram SC315-439.

9.2.5.2 Tympanic Temperature Conversion

Although temperatures taken using a tympanic probe are displayed only at the probe, there is a future provision for digital information from the probe to be coupled to the display PWA via a tympanic interface. As shown on sheet 3 of the schematic, digital information from the tympanic probe would pass through RFI filter L2, be inverted by Q3 and isolated by opto-isolator U11. The output from Q4 would be available at J1-10.

The tympanic temperature conversion circuits are shown at the top of sheet 3 of schematic diagram SC315-439.

9.2.5.3 Isolated Power Supply

The temperature conversion circuits are powered by an isolated +9V power supply that is powered by +8 V. As shown on sheet 3 of the schematic, Q1 and Q2, with associated components, comprise an astable multivibrator operating at 30 kHz nominal. The collector current flows through the primary of ferrite pot core transformer T1. A square wave appears at the secondary of T1 and is full wave rectified and filtered by CR1, CR2, and C7. Nominal output is +9 Vdc.

9.2.5.4 Precision Reference Voltage Supply

A precision adjustable shunt voltage regulator, U15, provides a nominal regulated reference voltage source of +3.24 Vdc for the thermistor input network, the reference network, and the VFC reference network. The reference is adjustable to compensate for initial tolerances in VFC U16 and timing capacitor C6, thereby, centering the dynamic range of the automatic calibration algorithm.

9.2.5.5 Predictive Temperature Probe Thermistor Interface

The excitation voltage and the load resistance are provided by R40 and R41. The thermistor is in parallel with R40. As the temperature increases the thermistor resistance decreases, causing the voltage at the junction of R40 and R41 to increase. The values of these resistors were selected to locate a linear temperature-to-voltage function around normal body temperature and to set the excitation voltage for maximum output without excessive self-heating effects at the thermistor.

9.2.5.6 Predictive Temperature Calibration and Probe Type Detector

A voltage divider comprising R44 - R47 divides the reference voltage at X1 and X2 into two voltages representing 10° C and 37° C. R42 and R43 trim the 37° C reference for minimum error at the most tightly specified accuracy point. The software periodically reads voltages X0 for 10° C and X1 for 37° C and adjusts the offset and scale factors for zero error at these two points, thus canceling the effects of drifts in the VFC and reference voltage. A voltage divider comprising R63 - R66 provides a 42° C reference voltage X2 which is read for self test of the temperature circuit and for identification of the probe type. When the rectal probe is attached, a jumper in the probe connector shorts E4 to E5 (pins J2-2 to J2-3) effectively shorting out R63 which shifts the 42° C standard slightly higher and allows the software to identify the probe type. This is necessary for the software to accurately predict a rectal temperature when in NORMAL mode.

9.2.5.7 Predictive Temperature Channel Selector

A CMOS analog multiplexer, U17, switches the input to the VFC (+VIN) among the three calibration sources (X0, X1, or X2) or to the probe interface (X3). The input is selected by the software via two bits SEL0-0 and SEL1-0 from data latch U14 which are patient-isolated by optoisolators U19 and U20.

9:2.5.8 Voltage-to-Frequency Converter

Voltage-to-frequency converter U16 is a monolithic VFC whose output is a square wave at a frequency determined by C6 and the current drawn from pin 3 (-VIN). The voltage at pin 3 follows the input voltage applied to pin 4 by virtue of an internal op-amp. Pin 3 is connected to the reference voltage through network R48 and R49 which (by Thevenin's Theorem) is equivalent to a voltage source behind the parallel combination of R48 and R49. The current out of pin 3 is, therefore, proportional to the difference between the input voltage at pin 4 and the open circuit voltage that would appear at the junction of R48 and R49 if U16 were disconnected. The combination results in a VFC with a scale factor and input offset established by the reference voltage, C6, R48, and R49.

9.2.5.9 Data Isolators

The square wave output of U16 is transmitted through opto-isolator U18 and J1-26 to the CPU PWA at E1-26 (digital input port). Control bits SEL0, SEL1 from data latch U14, are isolated by opto-isolators U19 & U20. These select lines are used to one of the four inputs to analog multiplexer U17.

9.3
PARTS LIST
(Refer to Foldout FO-9A)

ITEM	DESCRIPTION	PART NUMBER
C1	CAP,CERAMIC,RAD,Z5U,50V,20%,0.1UF	602-107
C2	CAP,CER 56PF 50V MIN 10% AXIAL	602-144
C3,4	CAP, ELCTLT, 22UF, 25V, AXIAL	604-109
C5,8	CAP,CERAMIC,RAD,Z5U,50V,20%,1.0UF	602-175
C6	CAP, POLYCARB 5% 0.2 IN 0.15UF	603-181
C7	CAP,TANTALUM 22UF 25V 20%	603-167
C9,10	CAP,CERAMIC,RAD,NPO,50V,5%,3900PF	602-199
C11	CAP,TANTALUM 4.7UF 35V 10%	603-149
C12,13, 15,16	CAP, CER 470PF,3000WVDC,20%	602-249
C14	CAP,CERAMIC,RAD,X7R,50V,10%,0.022UF	602-121
C17,18	CAP,CERAMIC,RAD,Z5U,50V,20%,0.01UF	602-104
CR1-5	DIO, SWITCHING 75V	610-104
DS1,32	DISPLAY, LED, 7-SEGMENT, RED	614-187
DS3,10, 17-19,33	DISPLAY,LED,7 SEGMENT,RED	614-123
DS5,7,8	DISPLAY,LED,7 SEG,YELLOW	614-139
DS16,30, 34,36	DISPLAY, LED 7 SEGMENT YELLOW	614-155
DS21,41, 42	LAMP, LED, GREEN ULTRA BRIGHT	614-178
DS25,26, 29,38	LAMP, LED, GREEN ULTRA BRIGHT	£614-178
DS27,28,43	LAMP, LED, YELLOW HIGH INTENSITY	614-177
DS31,35,40	LAMP,LED YEL LG RECTANGULAR	614-124
DS37	LAMP, LED, YELLOW HIGH INTENSITY	£614-177
DS44,45	LAMP, LED, GREEN ULTRA BRIGHT	†614-178
DS46	LAMP, LED, YELLOW HIGH INTENSITY	†614-177

£Domestic and English units only.
†French and German units only.

9.3
PARTS LIST (CONT)
(Ref FO-9A)

ITEM	DESCRIPTION	PART NUMBER
E4	CONTACT STRIP, EMI	608-282
J1	CONN., HEADER 26 POSN, W/SPACER	607-692
L1	INDUCTOR,2-LINE COMMON MODE CHOKE	669-141
L2,3	INDUCTOR, EMI FILTER	669-180
Q1-3	XSTR, AMPL NPN	674-102
Q4	XSTR,VMOS FET	676-105
R1,4-6,12, 15-17,28,61	RES, CF 1/4 WATT, 5% 6.2K OHM	650-171
R2,3,8-11, 13,14	RES, CF 1/4 WATT, 5% 51K OHM	650-162
R7	RES, CF 1/4 WATT, 5% 62K OHM	650-172
R18-24,27	RES, MF, 1/8 WATT, 1%, 10 OHM	652-205
R25,26	RES, CF 1/4 WATT, 5% 100K OHM	650-104
R29,31, 33-35	RES, CF 1/4 WATT, 5% 150 OHM	650-117
R30,50, 51,56	RES, CF 1/4 WATT, 5% 10K OHM	650-103
R32,52	RES, CF 1/4 WATT, 5% 3K OHM	650-143
R36,39	RES, CF 1/4 WATT, 5% 510 OHM	650-186
R37	POT, MULTI TURN, 1/2W, 10%, 1K	630-174
R38	RES, MF, 1/8 WATT, 1%, 1.74K OHM	652-322
R42	POT, MULTI TURN, 1/2W, 10%, 20K	630-187
R43	RES, MF, 1/8 WATT, 1%, 499K OHM	652-161
R53	RES, CF 1/4 WATT, 5% 1 OHM	650-207
R54,55	RES, MF, 1/8 WATT, 1%, 1K OHM	652-101
R57,58	RES, CF 1/4 WATT, 5% 1K OHM	650-102
R59,60	RES, CF 1/4 WATT, 5% 16K OHM	650-257
R62	RES, CF 1/4 WATT, 5% 22M OHM	650-246
R63	RES, MF, 1/8 WATT, 1%, 100 OHM	652-211
R64	RES, MF, 1/8 WATT, 0.1%, 4.99K OHM	652-326
R65	RES, MF, 1/8 WATT, 1%, 10K OHM	652-102
R66	RES, MF, 1/8 WATT, 0.1%, 1.07K OHM	652-327

9.3 PARTS LIST (CONT)
(Ref FO-9A)

ITEM	DESCRIPTION	PART NUMBER
RN1	RES,NETWORK 25PPM .1%,16 PIN DIP	§656-131
T1	TRANSFORMER DC/DC 1:1.2 TURN	668-140
TP2,3	CONTACT, PIN (.025SQ)POST	608-138
U1	IC,74HCT374,CMOS OCTAL D FF	619-185
U2,3	IC,TPQ2907,QUAD PNP XSTR ARRAY	621-195
U4	IC,74HCT175,CMOS QUAD D FF	619-184
U5,6	IC,ULN2803 DARL NPN DRIVER OCT	620-149
U7,8	IC,74HC238,3 TO 8 DECODER	619-183
U9,10	IC, 324 LIN QUAD OP-AMP	621-141
U11,18-20	IC, OPTOCOUPLER	625-112
U12	IC, CMOS NAND GATE	619-180
U13	IC, 4538 CMOS MULTIVIBRATOR	619-123
U14	IC, CMOS INV OCT D F-F,74HCTLS534	619-213
U15	IC,PROGRAMMABLE REF TL431	621-194
U16	IC, CMOS V-F CONV	619-212
U17	IC, CMOS 9CHAN MUX/DEMUX	619-113
	CABLE ASSY, TEMPERATURE	316-538
	CONTACT, EMI SHIELD	704-702
	SPACER, .3 IN. 7 SEGMENT LED	735-254
	SPACER, .3 IN., 7-SEGMENT LED	735-308
	TAPE,FOAM DBL ADHV 1/16X1.00	774-104
	NUT,SELF-LOCKING,NYLON INSR #6	716-401
	SCREW, 6-32X5/16 PNH PHH SST	719-107
	WASHER, FLAT #6 SST	723-103

§ALTERNATE PART FOR :

R40	652-324
R41	652-323
R44	652-327
R45	652-330
R46	652-329
R47	652-326
R48	652-328
R49	652-325
	607-261

SECTION 10. SYSTEM PROCESSOR PWA 315-437

10.1 INTRODUCTION

This section contains component information about system processor PWA 315-437 and the variations listed below:

Version	Part Number
Non-German, older units	315-437
Non-German, newer units	315-498
German, older units	315-471
German, newer units	315-499

10.2 PRINCIPLES OF OPERATION

The system processor PWA circuits are shown on schematic diagram SC315-437, located at the end of this section. The system processor test points are illustrated in Figure 10-1 and identified as follows:

TEST POINT	SIGNAL ASSIGNMENT
TP1	Master Clock (3.6864 MHz)
TP2	Read/Write Line Generated by System Processor
TP3	E Clock (0.9216 MHz) Generated by Gate Array (U2)
TP4	Q Clock (0.9216 MHz) Generated by Gate Array (U2)
TP5	FIRQ (2 MHz Interrupt Request) Generated by Gate Array (U2)
TP6	UCLK (1.8432 MHz USART Clock) Generated by (U2)
TP8	DMANB (Fail-safe Timer Reset) Generated by Gate Array (U2)
TP9	Fail-safe Timer Time-out
TP10	Analog Ground
TP11	VREF (Set by R48 to 4.50 Vdc)
TP13	FPT (Filtered Pressure Transducer) Analog Signal
TP16	Negative Voltage Source (-6.2Vdc)
TP17	Pressure Transducer Excitation Voltage (PTEXV)
TP18	Pressure Transducer Zero Bias (0.90 Vdc)

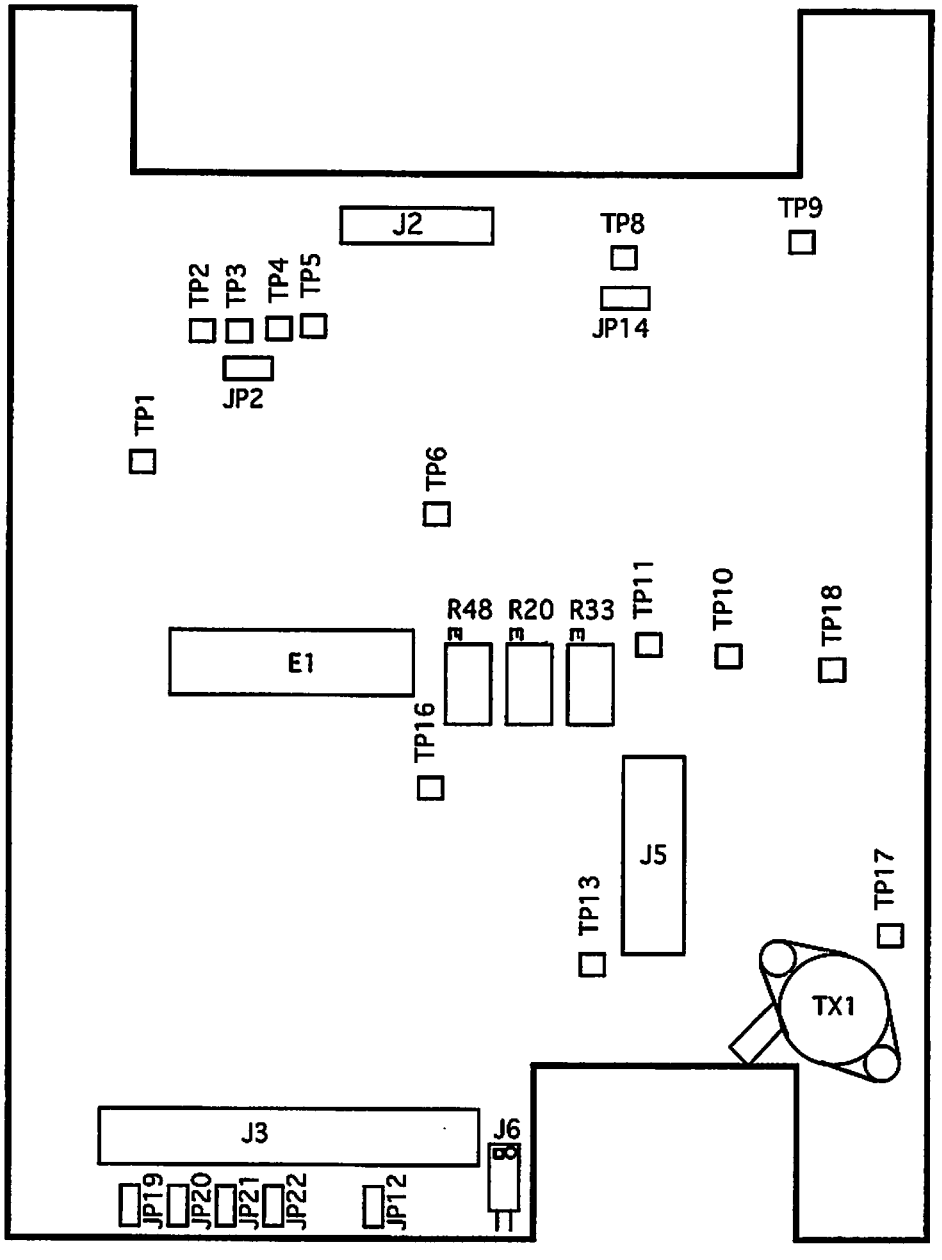


Figure 10-1. System Processor Test Points and Jumper Locations

10.2.1 Microprocessor System

The microprocessor system consists of a master clock circuit, a CMOS 8-bit microprocessor, a custom-designed gate array circuit, a 32Kx8 EPROM circuit, one 8Kx8 Static RAM, an analog-to-digital converter with digital I/O, and a digital output latch.

10.2.1.1 Master Clock Circuit

The master clock circuit is shown on sheet 2 of the schematic. It consists of CMOS inverter, U9, R1, R2, C1, C2, C3 and Y1, configured to form a crystal-controlled oscillator. The clock circuit oscillates between CMOS logic levels at a fundamental frequency of 3.6864 MHz. The master clock is sent directly to gate array U2. Here it is divided down to 0.9216 MHz to provide the E and Q clocks and the 2 millisecond FIRQ interrupt for system processor U1, and the 1.8432 MHz clock (UCLK) for Asynchronous Communications Interface Adapter (ACIA) U6 (sheet 3).

10.2.1.2 Microprocessor Circuit

The microprocessor circuit is shown on sheet 2 of the schematic. Microprocessor U1 is a CMOS 6309ECP, 8-bit surface-mounted processor. It has an 8-bit bi-directional data bus and a 16-bit address bus. It addresses the stored program in U4 (32Kx8 EPROM) and communicates with various I/O devices. Temporary storage (as long as power is on) for data generated by the operating program is provided by 8Kx8-bit CMOS static RAM U5.

The 6309ECP requires externally generated E (U1-38) and Q (U1-39) clock pulses and these are derived from the master clock and generated by the gate array, U2. The interrupt request line at U1-4, IRQ-0, is driven by ACIA U6 (sheet 3) which is enabled or disabled under software control. Interrupt request line FIRQ-0 at U1-5 is driven by the 1200 Hz interrupt generated by gate array U2, which triggers all the background tasks performed by the operating program. The read/write line at U1-36 is controlled by the microprocessor and is used by gate array U2, ACIA U6, and A/D converter and digital I/O U7, for gating data transfers from or to the data bus.

Reset line RESET-0 (U1-41) is driven by the power supply module through connector J5-18 in response to POWER ON and POWER OFF switch depressions. The reset line can also be controlled by an external source at JP2.

10.2.1.3 Gate Array Circuit

Gate array circuit U2 is shown on sheet 2 of the schematic. It is a custom-designed circuit that provides for high order address decoding, dividing the master clock to obtain various clock functions, controlling the processor interrupt (FIRQ), controlling the fail-safe timer reset pulse, and discrete digital I/O.

High order address decoding is provided for addressing certain internal functions, for generating certain select signals for devices external to the gate array, and for generating certain discrete digital I/O signals. The following table defines the addresses decoded, specifies their function and, where applicable, shows the output pin and signal name:

ADDRESS	FUNCTION	PIN#	SIGNAL
0000H to 07FFH	OUTPUT LATCH (U8) SELECT	U2-12	LTCHSEL-0
0800H to 0FFFH	FRONT PANEL DISPLAY SELECT	U2-43	DSPLSEL-0
1000H to 1FFFH	Not Used	-	-
2000H to 27FFH	A-to-D CONVERTER (U7) SELECT	U2-40	A/DSEL-0
2800H to 2FFFH	SERIAL INTERFACE (U6) SELECT	U2-19	ACIASEL-0
3000H to 30FFH	AUDIO ANNUNCIATOR	U2-37	BEEPER-1
3100H to 31FFH	Not Used	-	-
3200H to 32FFH	PNEUMATIC PUMP CONTROL	U2-35	PUMPON-1
3300H to 33FFH	DEFLATE VALVE CONTROL	U2-32	DEFLATE-0
3400H to 34FFH	EXT. COMMUNICATION CONTROL	U2-31	RXRRESET-0
3500H to 35FFH	EXT. COMMUNICATION CONTROL	U2-34	TXENAB-1
3600H to 36FFH	EXT. EQUIPMENT CONTROL	U2-29	AUXOUT-1
3700H to 37FFH	Not Used	-	-
3800H to 38FFH	SET FAIL-SAFE TIMER	U2-38	ZDMANB-0
3900H to 39FFH	ENABLE/DISABLE 1200 Hz INT.	Internal	-
3A00H to 3AFFH	CLEAR 1200 Hz FLAG/DEACT. INT.	Internal	-
3B00H to 3BFFH	READ 1200 Hz FLAG	U2-27	D7
3C00H to 3CFFH	RE-ARM FAIL-SAFE LOGIC	Internal	-
3D00H to 3DFFH	Not Used	-	-

3E00H to 3EFFH	READ AUX. INPUT	U2-44	AUXIN-0
3F00H to 3FFFH	COMPARE FAIL-SAFE TIMER	U2-39	U11-9
4000H to 7FFFH	RAM (U5) SELECT	U2-10	ZMCS1B-0
8000H to BFFFH	Spare Socket	U2-11	ZMCS2B-0
C000H to FFFFH	Not Decoded (ROM program)	-	-

A clock divider circuit which accepts the master clock pulse at U2-4 (ZOSC) and divides it down to 921.6 kHz to produce the quadrature E and Q clock pulses at U2-9 and U2-7, respectively. These quadrature clocks are also exclusive ORred within the gate array to produce the 1.8432 MHz clock signal (ZUCLK) which is output at U2-33 and sent to the ACIA circuit (U6) to control the Baud rate.

Q clock (921.6 kHz) is divided within the gate array by 768 to produce a 1200 Hz signal used by the gate array interrupt control logic. The interrupt control logic is under software control and allows the system processor to read or clear the state of an internal 1200 Hz timer flag and enable or disable the 1200 Hz interrupt (ZTIRQB). The internal 1200 Hz signal is used to set a flag in the gate array which may be read by the system processor by executing a read instruction of location 3B00H. A read to this location causes the gate array to gate the state of the 1200 Hz flag to the output (ZD7D) at U2-27 which is connected to bit 7 (D7) of the data bus. The 1200 Hz flag can be cleared by the system processor by writing anything to address 3A00H (this also clears the interrupt if it was enabled). Interrupt ZTIRQB (1200 Hz) may be enabled by writing a ONE in data bit 7 to address 3900H or disabled by writing a ZERO in data bit 7 to address 3900H)all other data bits are ignored). Interrupt ZTIRQB is output to the system processor at U2-8 whenever it is enabled and the 1200 Hz flag is set.

The fail-safe timer reset pulse at U2-38 is driven by control logic in the gate array that responds only to the proper sequence of certain software commands. In this way, the logic provides a system check of the microprocessor software during execution of the fail-safe timer reset pulse. The proper software sequence is:

1. Write 80H or higher to address 3800H.

2. Write 7FH or lower to address 3C00H.

The first instruction causes the gate array logic to generate a fail-safe timer reset pulse (ZDMANB) at U2-38. The signal goes low for one E clock cycle and then returns high. The second instruction re-arms the gate array software monitoring logic to detect the following error conditions:

1. Any write of 7FH or below to any address between 3800H and 38FFH, inclusive.

2. Any read of address 3800H to 38FFH, inclusive.

3. Two consecutive writes of 80H or above to any address between 3800H and 38FFH, inclusive, without an intervening write of 7FH or below to any address between 3800H and 38FFH, inclusive.

4. Any write of 80H or above to any address between 3C00H and 3CFFH, inclusive.

5. Any read of address 3C00H to 3CFFH, inclusive.

6. Two consecutive writes of 7FH or below to any address between 3C00H and 3CFFH, inclusive, without an intervening write of 80H or above to any address between 3800H and 38FFH, inclusive.

If any of these error conditions occur, the gate array logic sets a latch that disables the fail-safe timer reset strobe from being output to U2-38 and, thus, allow the fail-safe timer to time out in 4 seconds and produce the fail-safe alarm.

Discrete digital inputs are read from bit 7 (D7) on the data bus when reading the appropriate address. Discrete digital outputs are generated by writing to the appropriate address with the desired data on bit 7 (D7) of the data bus. The appropriate addresses, signal name, and logic state are shown in the address map above.

10.2.1.4 EPROM Circuit

The operating program for the Monitor is stored in CMOS 32K x 8 EPROM U4. The memory responds to addresses C000H through FFFFH with bit 15 of the address bus (A15) enabling the EPROM at U4-20 through inverter U9-8.

10.2.1.5 RAM Circuit

One CMOS 8K x 8 static RAM is provided in location U5. This provides temporary storage for a system processor scratchpad and for storing prior determination data. It is also used for storage of diagnostic programs which may be down-loaded through the communications port and executed by the system processor. The RAM is selected by the high-order address decode, ZMCS1B from gate array U2-10 allowing the RAM to respond to addresses in the range of 4000H to 7FFFH.

10.2.1.6 A/D Converter

Analog-to-digital converter U7, shown on sheet 3, is a CMOS, 16 channel, 8-bit A-to-D converter. The circuit is powered by the +5 Vdc logic supply at U7-27 and provided with the voltage reference (Vref) at U7-28. I/O transfers and A/D conversions are controlled by the chip select A/DSEL-0 (asserted by the gate array for addresses 2000H through 27FFH) at U7-14, the read/write line at U7-11, the system processor E clock at U7-12, and address bit A1 at U7-13. Address bit A1 is used internally by the converter to select control and data registers and to control double-byte transfers.

Nine analog input channels, AN0 through AN9 (there is no AN1), allow for digitizing (0 - 255) analog voltages in the range of +0 Vdc to +5 Vdc. The channel assignments are as follows:

CHAN	SIG	SOURCE
AN0	PT	This is the cuff pressure transducer signal in the range of +0 to +4.5 Vdc.
AN2	FPT	This is the filtered (AC coupled) pressure transducer signal (pulsatile complexes) in the range of +0 to +4.5 Vdc.
AN3	+5V	This is the +5 Vdc logic supply from the power supply at J5-5,6.
AN4	+8V	This is the +8 Vdc supply from the power supply at J5-9,10.
AN5	-V	This is the -6.2 Vdc nominal analog supply applied to Vref across R64 and R65 to give a positive representative voltage.
AN6	Vbs	This is the battery voltage divided by 3 from the power supply at J5-13.
AN7	Vbc	This is the battery charging voltage applied across voltage divider R66 and R67 representative of 13.6 to 30 Vdc.
AN8	PTEX V	This is the pressure transducer excitation voltage applied to pin 1 of the pressure transducer (TX1).
AN9	VLV SENSE	This is the voltage across R86 which is representative of the current drain of the valve coils in the pneumatics module brought in at J3-40. This is used only during manufacturing testing .

10.2.1.7 Digital I/O

Dedicated digital inputs PA4 through PA6 on U21 (sheet 4 of the schematic) are used to read the state of jumpers JP19 through JP21, respectively. JP19 is not used in the normal operation of the Monitor and should not be inserted.

On the Model 9302 Monitor, JP20 controls the target pressure display in the DIASTOLIC window. When no jumper is installed in JP20, the CUFF pressure at each deflation step is alternately displayed with the previous MAP determination in the MAP window. When JP20 is installed, only CUFF pressure is displayed in the DIASTOLIC window during a stepped deflation. JP20 is not used on the Model 9300, 9301, or 9303 Monitors.

On the Model 9340 and 9341 Monitors, JP20 selects the 12-minute predictive temperature mode. This is the default mode. Removing JP20 selects three minutes. JP21 enables the °C default when installed. The default is °F without JP21. JP20 and JP21 are not used on the Model 9342 and 9343 Monitors.

Digital I/O lines PA0 through PA2 on U21 are programmed as digital outputs at power on time and applied to CR15, CR14, and CR13, respectively. These digital outputs (KEYROW0, KEYROW1 and KEYROW2) sequentially strobe the switch matrix as a background task. CR13, CR14 and CR15 are used to preclude the possibility of simultaneous keyswitch closures burning out a digital output stage.

Shared digital ports (PB1 - PB5) interpret the voltage present on these pins (U21-12 through U21-16) as digital inputs. Inputs PB1 - PB5 are assigned to KEYCOL0 through KEYCOL3, respectively, and are used to sense keyswitch closures when KEYROW0 through KEYROW2 are output.

PA7 at U21-10 is available for future use to sample the digital output of a tympanic probe at E1-10. PB7 at U21-18 senses the occurrence of an overpressure condition, OP-1, which is sent from the pneumatics module via J3-12.

10.2.1.8 Digital Output Latch Circuit

Digital output latch U8 is shown on sheet 3 of the schematic. This circuit contains 8 CMOS flip-flops which have a common clock input at U8-11. The D inputs are steered by the microprocessor data bus and clocked by NAND gate, U10. U10 is enabled by LTCHSEL-0 which is generated by the gate array in response to an address in the range of 0000H to 07FFH. The output of U10 goes low during the Q clock and then, on the trailing edge of the Q clock, goes high to latch the data. The outputs of the latch control the offsets of the pressure transducer amplifier circuits, the filtered pressure transducer circuit test pulse (FPTTEST-1), adult/neonatal modes, and the zero and dump valve control signals (ZERO-1 and DUMP-0) which are sent to the pneumatics module via J3-16 and J3-15, respectively.

10.2.2 Analog Subsystem

10.2.2.1 Negative Bias Supply Circuit

A negative bias voltage supply is generated from the +8 volt supply on the system processor PWA to provide the negative rail for the analog circuitry. This negative supply circuit is shown on sheet 1 of the schematic. Three sections of U18 comprise an oscillator operating at about 20 kHz. Two sections of U18 buffer the output of this oscillator and drive the output amplifier made up of transistors Q3 and Q4, the output of which is a rectangular waveform of about 7.4 volts p-p. C24 and CR9 serve as a clamping level shifter to translate the pulse waveform such that the voltage at CR9 switches between +0.7 Vdc and -6.7 Vdc. CR8 rectifies this negative pulse to provide a supply of about -6.0 volts across C25, which filters out the switching components.

10.2.2.2 Pressure Transducer Circuit

Pressure transducer TX1 is excited by a constant current generator comprising Q1, Q2, and a section of U20. The current through the transducer is controlled by R17, which limits the current to 13.5 milliamperes. R16 provides the correct source impedance for proper temperature compensation of the pressure transducer. The output of the transducer, 40 to 60 mV at 255 mmHg pressure, is amplified by the differential amplifier using two additional sections of U20. The zero pressure offset of TX1 as well as the offset of the preamp are coarsely nulled by a voltage set by R33 (PT ZERO) and buffered by the fourth section of U20. On the Model 9302 Monitor, R102 is added to improve temperature stability. The scale factor is calibrated by R20 (SCALE ADJUST) trimmer and the gain of a section of U14 to be 1.00 mmHg/ADU, providing a nominal gain of 100 from the transducer to the A/D converter. CR3, CR4, and two sections of U14 serve to constrain the output of the transducer amplifier to voltages between 0 and 5.0 volts to ensure proper operation of the A/D converter.

10.2.2.3 Automatic Zero Setting Circuit

Auto Zero of the transducer channel is accomplished mainly in software. During calibration, the coarse offset trimmer is set for an A/D reading of 25 ±8. During auto zero, the processor activates the zero valve, records the PT reading from U14-7 through AN0 on A/D U7 and subtracts this reading from subsequent pressure readings. In order to preserve the capability of reading pressures above 200 mmHg, DASH50-1 from the processor through U8 (sheet 3 of the schematic) adds an offset to the PT signal through U17 and U14 (sheet 1 of the schematic) to reduce it by about 50 units. PLUS100-1 from U8 offsets the PT signal by +100 to +130 ADU, and is available to allow the processor to measure exactly the value of the DASH50 offset during auto zero time. During operation, if the A/D reading is 255, DASH50 goes TRUE, the A/D is read again, and the exact value of the DASH50 offset is added to the A/D reading. The stored zero offset may then be subtracted to obtain the pressure reading.

10.2.2.4 Oscillation Channel Amplifier Circuit

U15-5,-6,-7 (sheet 1 of the schematic) provides a low pass filter, U15-8,-9,-10 a switchable gain amplifier, and U15-1, -2,-3,-12,-13,-14 two clampable stages of high pass filter. CR6, CR7, and two sections of U15 provide a 0 to 5.0 volt clamp similar to the one in the PT channel.

Means are also provided to characterize the gain and frequency response of the FPT section during calibration mode or wait times. FPTTEST-1 is coupled through buffer U17-6,-7 into the PT channel ahead of the FPT pickoff point. The gain from this point is such that a controlled amplitude step voltage of about 1 mmHg is passed through the FPT channel. The resulting response can be digitized by the A/D converter (AN2) and features of the response compared against known correct values, establishing greater confidence in the operation of the analog section.

10.2.2.5 Reference Voltage Supply Circuit

U19, a programmable shunt regulator, provides an independent 4.50 volt source, VREF, to set the scale factor of A/D converter U7, the excitation current for pressure transducer TX1 through R33, as well as a stable source for the zero reference for the preamplifier and the calibrated 50 mmHg offset (U14). R48 is used to set this voltage to the correct value.

10.2.2.6 Power Supply Voltage Monitors

System supply voltages +5 volts, +8 volts, -6 volts, VREF, battery, and line power supplies are connected, through appropriate dividers (R60 - R65), to inputs on the A/D multiplexer (see sheet three of the schematic). These readings are compared against the correct ranges of values to operate the power supply alarms. Additionally, Vbc, the battery charger controller voltage, is used to indicate when line power is available. This information is used, along with the battery voltage, to control the state of the BATTERY LED.

10.2.3 Switchpanel Interface

The switch panel interface is shown on sheet 4 of the schematic. All switches on the front panel, except the ON and OFF switches, are wired in a matrix. This matrix is interrogated at a 40 Hz rate by the system processor through PIA U21. An interrogation sequence involves strobing each KEYROW line followed by reading each KEYCOL line to determine which, if any, keyswitch has been pressed.

KEYROW signals KEYROW0, KEYROW1 and KEYROW2 are developed by U21 digital I/O bits, PA0, PA1 and PA2, respectively. These digital I/O bits are programmed by the system processor at power-up to be digital output bits and are applied to the switch panel matrix at J2-4, J2-5 and J2-6, through diodes CR15, CR14 and CR13. These diodes prevent +5 Vdc from being applied to the digital outputs should two front panel switches be pressed at the same time.

While a digital "one" is applied to one of the KEYROW lines, the KEYCOL lines are read sequentially to determine which keyswitch is pressed. KEYCOL0, KEYCOL1, KEYCOL2 and KEYCOL3 are brought into the system processor PWA at J2-1, J2-2, J2-3 and J2-4, respectively. These are applied to U7 digital input channels PB1 through PB5. These channels are programmed to be digital input channels at power-up.

The front panel ON and OFF switches are brought into the system processor PWA at J2-8 and J2-9, respectively, and sent directly to the power supply through J5-17 and J5-19 as shown on sheet 1 of the schematic.

10.2.4 Display PWA Interface

The display PWA is an output device which is controlled by data transfers from the system processor. Most of the interface circuits are shown on sheet 2 of the schematic. The display PWA is selected by DSPSEL-0 which is generated by the high order address decode circuit in the gate array, U2. Any I/O data transfer in the range of 0800H to 08FFH causes DSPSEL-0 from U2 to be asserted and sent to the display PWA via E1-9. Low order address bits A0 through A3 are driven directly by the system processor and sent to the display PWA via E1-11 through E1-14, respectively. Data bits D0 through D7 are driven directly by the system processor and sent to the display PWA via E1-18 through E1-25, respectively. Data transfers are synchronized with the system processor by the Q clock, QCLK, which is generated by gate array U2 and sent to the display PWA via E1-8.

Supply voltage is brought in from the power supply and routed directly to the display PWA from E1-1 and E1-2 as shown on sheet 1 of the schematic.

MAINSLED is derived from battery charger voltage Vbc as shown on sheet 3 of the schematic. Vbc is brought in from the power supply at J5-14 and is present only when the AC line power is connected and turned on at the power entry module. This voltage is reduced by R68 and sent to the display PWA via E1-7 where it is used as drive voltage for the MAINSLED.

10.2.5 Pneumatics PWA Interface

The pneumatics PWA interface is effected at J3 of the system processor PWA. These signals are shown on all sheets of the schematic.

The pneumatic valve control signals are ZERO-1, DUMP-0 and DEFLATE-0. The auto zero valve is controlled by ZERO-1 which is a discrete digital output bit generated by digital latch U8 at J3-18 as shown on sheet 3. When ZERO-1 is true, the auto zero valve applies the pneumatic line from the pressure transducer to atmosphere. When ZERO-1 is not asserted, the auto zero valve applies cuff pressure to the pressure transducer. The dump valve is controlled by DUMP-0 which is a discrete digital output bit generated by digital latch U8 at J3-15 as shown on sheet 3. When DUMP-0 is true, the dump valve ports the cuff pressure line to atmosphere. When DUMP-0 is not asserted, the dump valve ports the output of the air pump to the cuff pressure line. The deflate valve is controlled by DEFLATE-0 which is a discrete digital output bit generated by the gate array U2 at J3-14 as shown on sheet 2. When DEFLATE-0 is true the deflate valve is de-energized and applies the cuff pressure line to atmosphere. When DEFLATE-0 is not asserted, the deflate valve is energized to block the cuff pressure deflate line.

The air pump control signal (PUMPON-1) is a discrete digital output bit generated by gate array U2 at J3-13 as shown on sheet 2. When PUMPON-1 is asserted, it enables regulated DC power to be applied to the air pump.

The pneumatic system reset signal, PNEURESET-1, is used to reset the overpressure signal latch in the pneumatics PWA and is required to be a positive-going edge whenever the Monitor is first turned on or whenever the front panel CANCEL switch is pressed. When the Monitor is first turned on, the power supply asserts RESET-0 and holds it low for approximately 50 milliseconds. After RESET-0 goes high, PNEURESET-1 is asserted, and, after a time delay, is PNEURESET-1 unasserted.

The pneumatic system reset signal, PNEURESET-1, is generated by PIA U21 and four-bit latch U22 as shown on sheet 4. When RESET-0 is asserted, U22 is cleared and U22-14 (Q3-0) goes high asserting PNEURESET-1. When RESET-0 goes high, U22, which is wired as a divide-by-four down counter, begins to count down at one-second intervals (U22 is driven by 1HZ_CLK at pin 9). After approximately four seconds, U22-14 goes low and PNEURESET-1 is unasserted. To allow for resetting the overpressure latch by pressing the CANCEL switch, PIA U21 interprets this by bringing CB2 (pin 20) low, resetting latch U22, thus asserting PNEURESET-1 for the duration of the switch panel interrogation pulse.

10.2.6 Failsafe Timer Circuit

The failsafe timer circuit is shown on sheet 2 of the schematic. This circuit consists of crystal-controlled oscillator Y2, clock divider U12, and binary counter U11. It performs two functions:

- It acts as a fail-safe timer which times out in 4 seconds if not reset by the microprocessor through the gate array, and
- It provides a crystal-controlled time base for periodic comparison to the microprocessor clock as a system check.

U12 is a 7-stage ripple counter which divides the oscillator frequency of 32.768 kHz down to a 2 Hz signal (U12-3) which is used to clock the binary counter, U11.

At power on time, RESET-0, which is generated by the power supply and resets U11 from U10. Thereafter, the microprocessor must periodically generate ZDMANB-0 through gate array U2 before the binary counter tallies 4 seconds. ZDMANB-0 is capacitively coupled to U10 by C9 to prevent a stuck bit from holding the counter reset. If the microprocessor should fail to generate the reset in some way, U11-6 will go high after 4 seconds since the last reset and hold the clock divider in a clear state at U12-12. When U11-6 goes high, it generates the fail-safe alarm, FSALARM-0 through U9-10. FSALARM-0 is sent to the pneumatics module through J3-17 where it is used to generate the audio alarm and inhibit the valve drive circuits. The fail-safe alarm at U9 is also used to disable the TXEN-0 signal at U10-6 which is sent to the external communication port on the pneumatics module.

The third stage of the binary counter (U11-9) is periodically (at least twice a minute) read by the microprocessor as a digital input through gate array U2 as ZIBIT7 to check the oscillator circuits. If the comparison shows that one of the oscillators is off frequency by more than ±0.5%, the microprocessor generates the 901 alarm and stops Monitor operation.

10.2.7 External Communications and Control

The external communications and control circuits are shown on sheet 3 of the schematic. AUXIN-0, AUXOUT-0, RXR-1 and TXE-1 are not supported by the software at this time. The software does support serial communications between the Asynchronous Communications Interface Adaptor (U6) and an external device capable of receiving logic level (0V = MARK, +5V = SPACE) serial communication signals in ASCII format at 600 baud. Received signal RxD-0 is terminated by a 10k ohm resistor, R72, and applied to the input of a CMOS inverter, U13. CR11 is a 5.1V Zener which allows RS232 logic levels to be applied as signal inputs. Transmit line TxD-0 is output by the CMOS inverter, U13.

10.3
PARTS LIST
(Refer to Foldout FO-10A)

ITEM	DESCRIPTION	PART NUMBER
C1,3	CAP,CERAMIC,SMD,NPO/COG,50V,39 PF	605-120
C2,4-8,10, 11,14-19, 26-29,33,34, 36,40-42, 103-112	CAP,CERAMIC,SMD,Z5U,50V,0.10 UF	605-325
C9,38,39, 43,113, 115-117,119	CAP,CERAMIC,SMD,X7R,50V MIN,0.010 UF	605-221
C12	CAP,CERAMIC,SMD,NPO/COG,50V,33 PF	605-119
C20,21	CAP, POLY, RAD, 100V, 5%, 0.10 UF	603-113
C22,23	CAP, POLY, RAD, 100V, 5%, 1.0 UF	603-114
C24,25,101	CAP, ELCTLT 100UF 25V RADIAL LEAD	604-162
C30	CAP, ELCTLT, 1000UF 16V	† 604-148
	CAP, ELCTLT, 22UF, 25V, AXIAL	‡ 604-109
C31	CAP, ELCTLT, 22UF, 25V, AXIAL	604-109
C32	CAP, ELCTLT 10 UF, 50V, 20%	604-183
C35	CAP,CERAMIC,SMD,NPO/COG,50V,82 PF	605-124
C100	CAP,CERAMIC,SMD,X7R,50V MIN,1000 PF	605-209
C102	CAP,CERAMIC,SMD,X7R,50V MIN.,0.10 UF	605-233
CR3-10, 13-16	DIO SWI, 200 MA, 70V, SMD	610-114
CR11,12	DIO ZENER 5.1V, 5%, 225MW SURF MOUNT	612-127
E1	CONN, THRU-BOARD 26 POSN, FEMALE	607-582
J2	CONNECTOR,HEADER,10 POS RT ANG	607-456
J3	CONNECTOR,20/40,CARD EDGE	607-453
J5	CONNECTOR,10/20, CARD EDGE	607-454
J6	CONN,2 CONTACT RIGHT ANGLE HEADER	607-617
JMP14	CONNECTOR, SHUNT, 2 POSITION	607-297
JP2,12,14, 19-22	CONTACT, PIN (.025SQ)POST	608-138

† Used only on CPU 315-498 and 315-499
‡ Used only on CPU 315-437 and 315-471

10.3 PARTS LIST (CONT)
(Ref FO-10A)

ITEM	DESCRIPTION	PART NUMBER
Q1,3	XST NPN 2222A SMT	674-127
Q2,4,5	XST PNP SMT	674-126
R1	RESISTOR, SMD, 1/8 WATT, 1%, 475K OHM	654-550
R2	RESISTOR, SMD, 1/8 WATT, 1%, 1.21K OHM	654-301
R3,4,22,27, 49,50,67, 71-74,79-82, 100,105	RESISTOR, SMD, 1/8 WATT, 1%, 10.0K OHM	654-389
R5,9,14,15, 19,25,28,45, 70,75-77	RESISTOR, SMD, 1/8 WATT, 1%, 1.00K OHM	654-293
R6	RESISTOR, SMD, 1/8 WATT, 5%, 4.7M OHM	654-597
R7,30	RESISTOR, SMD, 1/8 WATT, 1%, 47.5K OHM	654-454
R10-13,23, 86,103	RESISTOR, SMD, 1/8 WATT, 1%, 20.0K OHM	654-418
R16,87	RESISTOR, SMD, 1/8 WATT, 1%, 1.82K OHM	654-318
R17	RESISTOR, SMD, 1/8 WATT, 1%, 75.0 OHM	654-185
R18,29, 60-64	RESISTOR, SMD, 1/8 WATT, 1%, 49.9K OHM	654-456
R20,33	POT, MULTI TURN, 1/2W, 10%, 10K	630-148
R21,32	RESISTOR, SMD, 1/8 WATT, 1%, 14.3K OHM	654-404
R24,39,43, 56,69	RESISTOR, SMD, 1/8 WATT, 1%, 2.00K OHM	654-322
R26	RESISTOR, SMD, 1/8 WATT, 1%, 40.2K OHM	654-447
R31,51, 65,66	RESISTOR, SMD, 1/8 WATT, 1%, 100K OHM	654-485
R34	RESISTOR, SMD, 1/8 WATT, 1%, 51.1K OHM	654-457
R35	RESISTOR, SMD, 1/8 WATT, 1%, 61.9K OHM	654-465
R36	RESISTOR, SMD, 1/8 WATT, 1%, 649 OHM	654-275
R37,38	RESISTOR, SMD, 1/8 WATT, 1%, 221K OHM	654-518
R40,53	RESISTOR, SMD, 1/8 WATT, 1%, 332K OHM	654-535
R41	RESISTOR, SMD, 1/8 WATT, 1%, 1.33K OHM	654-305
R42	RESISTOR, SMD, 1/8 WATT, 1%, 110K OHM	654-489

10.3 PARTS LIST (CONT)
(Ref FO-10A)

ITEM	DESCRIPTION	PART NUMBER
R44	RESISTOR, SMD, 1/8 WATT, 1%, 23.7K OHM	654-425
R46,78	RESISTOR, SMD, 1/8 WATT, 1%, 750 OHM	654-281
R47	RESISTOR, SMD, 1/8 WATT, 1%, 8.06K OHM	654-380
R48	POT, MULTI TURN, 1/2W, 10%, 1K	630-174
R52	RESISTOR, SMD, 1/8 WATT, 1%, 1.15K OHM	654-299
R54	RESISTOR, SMD, 1/8 WATT, 1%, 75.0K OHM	654-473
R55,58,59, 88-90	RESISTOR, SMD, 1/8 WATT, 1%, 3.01K OHM	654-339
R57	RESISTOR, SMD, 1/8 WATT, 1%, 35.7K OHM	654-442
R68	RESISTOR, SMD, 1/8 WATT, 1%, 5.11K OHM	654-361
R102 ¥	RESISTOR, SMD, 1/8 WATT, 1%, 866K OHM	654-575
	RESISTOR, SMD, 1/8 WATT, 1%, 681K OHM	654-565
	RESISTOR, SMD, 1/8 WATT, 1%, 549K OHM	654-556
	RESISTOR, SMD, 1/8 WATT, 1%, 464K OHM	654-549
	RESISTOR, SMD, 1/8 WATT, 1%, 402K OHM	654-543
	RESISTOR, SMD, 1/8 WATT, 1%, 357K OHM	654-538
	RESISTOR, SMD, 1/8 WATT, 1%, 324K OHM	654-534
	RESISTOR, SMD, 1/8 WATT, 1%, 287K OHM	654-529
	RESISTOR, SMD, 1/8 WATT, 1%, 267K OHM	654-526
	RESISTOR, SMD, 1/8 WATT, 1%, 243K OHM	654-522
	RESISTOR, SMD, 1/8 WATT, 1%, 226K OHM	654-519
	RESISTOR, SMD, 1/8 WATT, 1%, 210K OHM	654-516
	RESISTOR, SMD, 1/8 WATT, 1%, 196K OHM	654-513
	RESISTOR, SMD, 1/8 WATT, 1%, 174K OHM	654-508
	RESISTOR, SMD, 1/8 WATT, 1%, 165K OHM	654-506
	RESISTOR, SMD, 1/8 WATT, 1%, 158K OHM	654-504
	RESISTOR, SMD, 1/8 WATT, 1%, 147K OHM	654-501
	RESISTOR, SMD, 1/8 WATT, 1%, 140K OHM	654-499
	RESISTOR, SMD, 1/8 WATT, 1%, 133K OHM	654-497
	RESISTOR, SMD, 1/8 WATT, 1%, 127K OHM	654-495
	RESISTOR, SMD, 1/8 WATT, 1%, 124K OHM	654-494
	RESISTOR, SMD, 1/8 WATT, 1%, 182K OHM	654-510

¥ On CPU 315-471 or 315-499 only, R102 is selected from the listed items

10.3 PARTS LIST (CONT)
(Ref FO-10A)

ITEM	DESCRIPTION	PART NUMBER
R104	RESISTOR, SMD, 1/8 WATT, 1%, 10.0 OHM	654-101
RN1	RES 15-10K NETWORK SMT	656-133
TP10,11	CONTACT, PIN (.025SQ)POST	608-138
TX1	TRANSDUCER,PRESSURE 0-10 PSI	662-151
U1	IC, CMOS UP 6309E SMT SURFACE MOUNT	692-107
U2	IC, CMOS GATE ARRAY, SURFACE MOUNT	619-227
U5	IC,SMD,6264,SRAM,8KX8,85 NSEC	692-108
		or 622-139
U6	IC, R65C51 CMOS SMT ASYNCHRONOUS	692-106
U7	IC, 14442 A/D SMT	‡ 693-103
	IC, A/D SMT	† 693-164
U8	IC 74HCT374 OCTAL D FLIP FLOP SUR. MT.	692-103
U9	IC, SMT, 74HCU04 HEX INVERTER	692-100
U10	QUAD NAND GATE W/SCHMITT INPUTS	692-165
U11	IC 4024 RIPPLE COUNTER SMT	692-101
U12	IC MC74HC4060 BINARY RIPPLE CNTR SMT	692-104
U13,18	IC MC14049 HEXBUF INVERTING SUR. MT.	693-100
U14,15,20	IC, JFET OP-AMP, SMD SURFACE MOUNT	691-100
U16	IC, ANALOG SWI SUR. MT.	692-105
U17	IC 4050 HEXBUF NON-INVERTING SMT	693-101
U19	IC TL431 PROG. PREC. REFERENCE SMT	693-102
U21	IC 65C21 PIA SMT	694-100
U22	IC 75HC175 SMT QUAD D FLIP FLOP	692-109
X1	SOCKET,DIP LOW PROFILE 28 PIN	607-491
Y1	CRYSTAL 3.6864 MHZ .005%	609-109
Y2	CRYSTAL,32.768 KHZ	609-105
#79	TYWRAP NYLON .75 BDL DIA.MAX.	756-101
#81	TAPE,FOAM DBL ADHV 1/16X1.00	774-104
#82	TUBING PHARMED	740-185
#122	TUBING,SHRINKABLE 1/8 ID CLEAR	† 742-110

‡ Used only on CPU 315-437 and 315-471
† Used only on CPU 315-498 and 315-499

SECTION 11. POWER SUPPLY PWA 315-372

11.1 INTRODUCTION

This section contains component information about the battery charger control circuit and the following power supply PWAs:

Version	Part Number
Older units	315-372
Newer units	315-503

11.2 PRINCIPLES OF OPERATION

The circuits for both power supply PWA types are shown on schematic diagram SC315-372, located at the end of this section. The circuits are functionally divided into five parts.

The power supply test point locations are shown in Figure 11-1 and are identified as follows:

TEST POINT	SIGNAL ASSIGNMENT
TP1	Excitation Oscillator Output
TP2	Regulator Drive Input
TP3	Battery Charger Reference Frequency
TP4	Battery Voltage Vb
TP5	Switched Power Vs

11.2.1 Unregulated Air Pump Supply

The unregulated air pump supply voltage appears across filter capacitor C1 and is supplied to the pneumatics PWA through the system processor PWA as Vp at J2-1,2. This supply is fed from the battery through CR5 and from the line power transformer through bridge rectifier CR6. When line power is applied, Vp is higher than the battery voltage and reverse biases CR5. When line power is not applied, Vp is provided by the battery through CR5 with the rectifiers in CR6 isolating the transformer. Vp varies from about 10 Vdc with a nearly discharged battery to about 32 Vdc with high line voltage and low load.

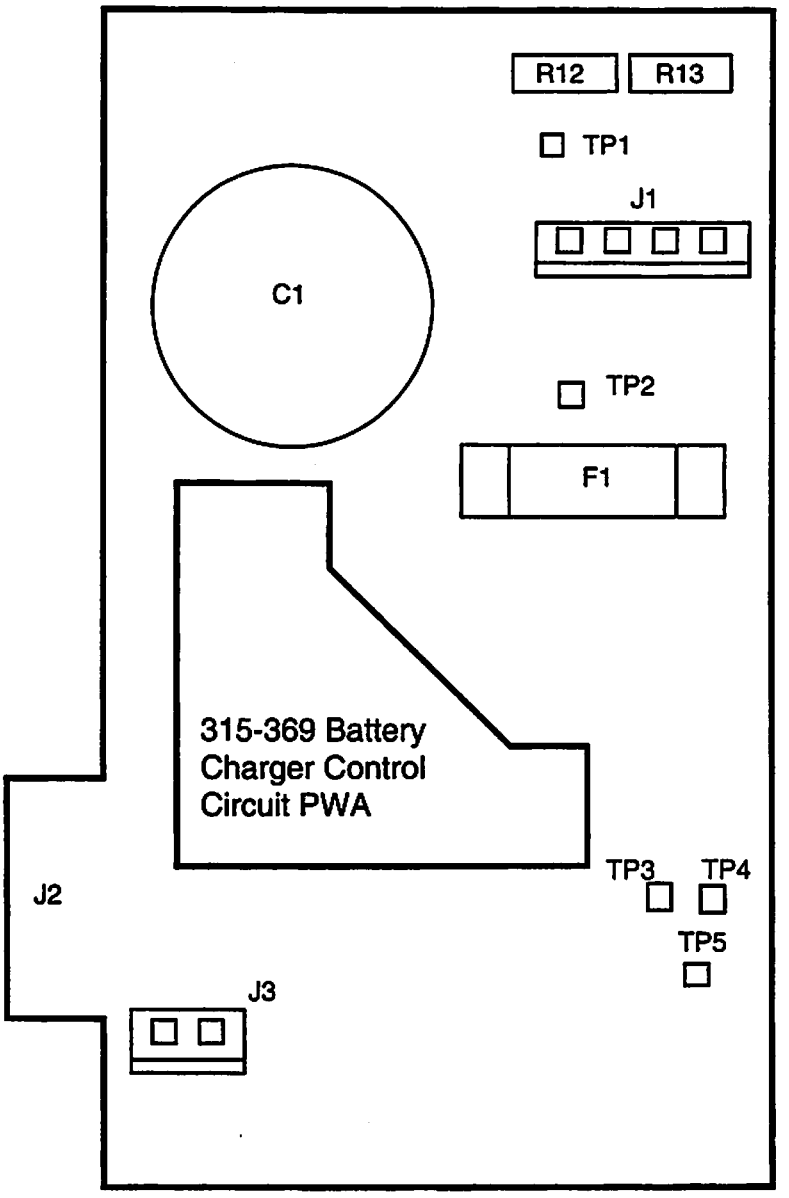


Figure 11-1. Power Supply Test Point Locations

11.2.2 Regulated +5 and +8 VDC Supplies

These regulated supplies are provided by pulse width modulated step-down switching regulators. In this type of regulator, a switching device generates a pulse with a peak value nearly equal to the input voltage, a minimum value nearly equal to zero, and an average value equal to the desired output voltage. This pulse waveform is then passed through a reactive (lossless) lowpass filter to remove switching frequency components and pass the average DC signal as the output voltage. In a closed loop regulator such as this the output voltage is compared to a reference voltage and the duty cycle is varied to adjust the output to the desired voltage in response to input voltage and output load variations.

U1 is a quad voltage comparator with open collector outputs. U1A comprises an astable multivibrator, called the reference oscillator, which establishes the switching frequency and output voltages of the +5 and +8 Vdc supplies. U1B controls the +5 Vdc output transistor, Q4, and U1D controls the +8 Vdc output transistor, Q5. U1C is unused.

Q4 is the switching device for the +5 Vdc supply and is driven on and off by the output of U1B. During the on part of the cycle, the collector of Q4 is switched to Vp, less the on drop of the transistor (about 1 Vdc), causing a linear increase in current through L2. When the transistor is turned off, the inductor current continues to flow but has to take the alternate path through CR3, a high-speed switching diode. Therefore, the collector voltage is one diode drop below zero volts, reversing the polarity of the voltage impressed across L2 and causing the current through L2 to linearly decrease. The output voltage is compared to the reference triangle wave by comparator U1B. If the output voltage is at or below the minimum voltage of the triangle, Q4 will be turned on 100% of the time. Conversely, if the output voltage is above the maximum voltage of the reference triangle, Q4 will be continuously off. In operation, a steady state is reached with the output voltage at a point such that the duty cycle is correct for the established voltage. Any required duty cycle from 5% to 100% can be obtained with the feedback (output, in the case of the +5 Vdc supply) within 100 millivolts of the reference value. The duty cycle will be approximately the ratio of output to input voltage. Note that the loop gain and, therefore, the regulation is established by the peak-to-peak voltage of the reference triangle; the higher this amplitude, the lower the loop gain.

Current limiting action is effected by Q1 and Q4. The peak input current, which is equal to the output current, flows through R2. When the voltage drop across R2 is sufficient to turn on Q1, the collector current from Q1 charges C2 to a voltage which adds to the feedback voltage. The comparator sees a higher feedback voltage and lowers the duty cycle to limit the output current to a safe value.

The +8 Vdc supply operates in a similar manner except that the output voltage is attenuated by a factor of 5/8 (R21 and R22) to cause the feedback voltage at the comparator to be +5 Vdc when the output is at +8 Vdc. The comparator is provided with open collector outputs. Removing power from comparator U1, therefore, removes base drive from the switching transistors and shuts down the supplies.

11.2.3 ON/OFF Control and Low Battery Shutdown

Quad CMOS gate U5 is powered at all times from Vp, with its supply voltage limited to a safe value by Zener diode CR7. FET Q15 is used to reduce battery drain while the Monitor is off.[1] This Zener voltage was selected so that it draws no current when only battery power is available. This prevents discharging the battery when the unit is off. Bistable flip-flop U5A and U5B stores the on/off state of the Monitor and is set and reset by the front panel ON and OFF switches. The output of this flip-flop drives the base of emitter-follower Q12 whose output is one junction drop below the CMOS gate supply voltage. Thus, this switched supply is limited to about 13.4 Vdc. This emitter-follower output supplies power to reference shunt regulator U4 and the emitter of Q8. When the emitter of Q12 is at least one junction drop above the reference voltage, Q8 conducts and supplies power (Vs) to the comparator U1A, turning on the regulated supplies.

The +8v supply turns on Q7 that connects battery voltage Vb to voltage divider circuit R31 and R20 and sends switched battery voltage Vbs to the system processor through J2-9,10 for monitoring. When battery voltage Vbs drops to about 10.7 volts, the battery LED begins to flash and the system processor sends an audible alarm signal at one-minute intervals to the audio annunciator on the pneumatics PWA.

When the Monitor is using only the battery, Vp is one junction (CR5) below battery voltage Vb. As the battery voltage continues to drop, Vp falls below the threshold set by U4, Vs turns off, removing power from comparator U1A. R34 supplies a small amount of positive feedback to reference U4 for threshold hysteresis and fast switching of Vs. Removing Vs from on-off latch U5-12 latches it to the off state. This action turns off the Monitor preventing deep discharging the battery.

11.2.4 Logic System Master Reset Circuit

When Vs is off, gate U5 turns on FET Q10, holding the reset line (RESET-0) low (TRUE). When Vs switches on, C13 begins to charge through R42. After a delay of about 40 to 104 milliseconds, RESET-0 is high (FALSE) and allows the processor to start. Upon removal of Vs, CR15 discharges C13 through R33 and the CMOS output of U5-3 quickly to re-arm the time delay circuit. CR15 was changed to a Zener diode to reduce reset delay.

11.2.5 Battery Charger Circuit

The power supply contains a piggy-back PWA (315-369) that provides fast charging of the battery.

When line power is available, the switching regulator U3 and U1-pb (pb indicates piggy-back PWA—315-369), receive power from a separate DC supply, Vbc, supplied by rectifiers CR8 and CR9. U3 drives the switching transistor Q11, which supplies power from Vp to charge the battery. Resistor R6-pb, senses the charging current and turns on Q6 when the current exceeds about 400 mA. Q6 drives the current limit input of U3, reducing the pulse width. When the unit is turned off, that state is sensed at U1-pb pin 5, R5-pb shunts Q6 increasing the current through the current sense resistor at which Q6 turns on to approximately 650 mA. R12 adjusts the float voltage to the proper value, 13.75v. (This should be done with a charging current of approximately 20 mA.) A fast charge voltage (approximately 1v higher than the float voltage), is obtained by the shunting of R11 by R4-pb. This action lowers the voltage to the inverting input of the voltage control for pulse width modulator U3 resulting in a higher charging voltage. Charging voltage is about 14.7v until the charging current falls below approximately 40 mA. Current is sensed by U1-pb pins 2 and 3. Hysteresis is provided for by C1-pb and by the drop in charging voltage. Q2 disconnects the feedback network from the battery when the battery charger is not operating so that the battery is not discharged.

11.3
PARTS LIST
POWER SUPPLY PWA
(Refer to Foldout FO-11A)

ITEM	DESCRIPTION	PART NUMBER
C1	CAP,RAD,ELECT,35V,20%,10000 UF	604-147
C2,5,7,8	CAP,CERAMIC,RAD,Z5U,50V,20%,0.1UF	602-235
C3,4,9,11	CAP, ALUM ELECT 100UF, 35V MIN.	604-145
C6	CAP, POLY, RAD, 100V, 5%, 0.010 UF	603-109
C10	CAP, POLY, RAD, 100V, 5%, 1000 PF	603-106
C12	CAPACITOR, 22UF, 50V ALUM ELECT	603-170
C13,15	CAP, CERAMIC 1UF, 50W VDC, 20%	602-224 or 602-175
C14	CAP,CER 1000P 50V 10% AXIAL	602-158
CR1,8,9	DIO, RECT 1AMP 400V	610-103
CR2,3,4	DIODE, RECT, 1A 40V	611-126
CR5	DIO, RECT 6AMP 50V	611-104
CR6	RECTIFIER,ASSY 1.5AMP 50V	647-107
CR7	DIO,ZENER 14V 5% .5W 1N5244B	612-405
CR11	DIO, SWITCHING 75V	610-104
CR15	DIO,ZENER 33V 5% .5W 1N5257B	612-116
F1	FUSE 2AMP 250V FAST ACTING	628-133
J1	CONNECTOR, HEADER, 4 POSN	607-458
J3	CONNECTOR,HEADER,2 POSN	607-457
L1-3	IND,AXIAL,1.0A,680 UH	669-139
L4	IND,AXIAL,1.0A,680 UH	¥ 669-139
Q1,3,6,8	TRANSISTOR, SWITCH PNP	674-138
Q2,7,10	XSTR,VMOS FET	676-105
Q4,5	XSTR,PNP,DLNGTN 2A 50W	673-109
Q11	XSTR, POWER MOSFET	676-154
Q12	XSTR, SW NPN	674-403
Q15	XSTR,J-FET,N-CHANNEL, DEPLETE,310MW	676-139
R1,16	RES, CF 1/4 WATT, 5% 47 OHM	650-160
R2,17	RESISTOR MF .56 OHM 5% 1W	653-144
R3,8,14,19, 23,37,47	RES, CF 1/4 WATT, 5% 1K OHM	650-102
R4,6,15,18	RES, CF 1/4 WATT, 5% 2K OHM	650-126

¥ Used only on 315-503

11.3
PARTS LIST
POWER SUPPLY PWA
(CONT)
(Ref FO-11A)

ITEM	DESCRIPTION	PART NUMBER
R5,10,35	RES, MF, 1/8 WATT, 1%, 10K OHM	652-102
R7	RES, CF 1/4 WATT, 5% 68K OHM	650-175
R9	RES, CF 1/4 WATT, 5% 15K OHM	650-184
R11	RES, MF, 1/8 WATT, 1%, 2K OHM	652-127
R12	POT, SINGLE TURN, 1/2W, 10%, 1K	630-114
R13	POT, SINGLE TURN, 1/2W, 10%, 5K	630-173
R20	RES, MF, 1/8 WATT, 1%, 8.06K OHM	652-191
R21,25,27	RES, MF, 1/8 WATT, 1%, 4.99K OHM	652-159
R22	RES, MF, 1/8 WATT, 1%, 3.01K OHM	652-145
R24	RES, MF, 1K OHM, 5%, 1/2W	653-161
R26,28	RES, CF 1/4 WATT, 5% 100 OHM	650-101
R29,40,41	RES, CF 1/4 WATT, 5% 27K OHM	650-139
R30	RES, CF, 1/2 WATT, 5%, 2.7 OHM	‡ 651-117
R31	RES, MF, 1/8 WATT, 1%, 20K OHM	652-128
R32	RES, MF, 1/8 WATT, 1%, 10.7K OHM	652-250
R33	RES, CF 1/4 WATT, 5% 10K OHM	650-103
R34	RES, CF 1/4 WATT, 5% 220K OHM	650-132
R36	RES, MF, 1/8 WATT, 1%, 29.4K OHM	652-227
R38	RES, CF 1/4 WATT, 5% 430 OHM	650-200
R42,43	RES, CF 1/4 WATT, 5% 100K OHM	650-104
R46	RES, CF 1/4 WATT, 5% 1M OHM	650-105
R48	RES, ZERO OHM 1/8W COATED	650-213
TP1-5	CONTACT, PIN (.025SQ)POST	608-138

‡ Used only on 315-372

11.3
PARTS LIST
POWER SUPPLY PWA
(CONT)
(Ref FO-11A)

ITEM	DESCRIPTION	PART NUMBER
U1	IC, COMPARATOR	621-151
U2,4	IC,PROGRAMMABLE REF TL431	621-194
U3	IC, REGULATOR PULSE WIDTH	621-157
U5	IC, CMOS 4 2-INPUT NAND	619-106
#9	FUSE CLIP ELEC	736-403
#56	PWA,BATTERY CHARGER CONTR CIRCUIT	315-369
#57	TAPE,FOAM DBL ADHV 1/16X1.00	774-104
#58	TUBING,CLEAR TEFLON 200/20	740-118
#59	WIRE, HOOK UP, TINNED COPPER 20 AWG	680-328
#60	WIRE, 26AWG SOLID INSUL RED	680-103
#61	WIRE, 26AWG SOLID BLUE	680-107
#62	CONN, HEADER 6 PIN MALE	607-706
#69	SPACER, TRANSISTOR T018	735-306

11.4
PARTS LIST
BATTERY CHARGER
CONTROL CIRCUIT
PWA 315-369
(Ref Fig. 11-2)

ITEM	DESCRIPTION	PART NUMBER
C1	Capacitor, ceramic, 0.1 microfarad, 50V, ±20%	602-106
R1	Resistor, Metal Film, 1.15k ohm, ±1%, 1/8W	652-222
R2	Resistor, Metal Film, 169k ohm, ±1%, 1/8W	652-122
R3	Resistor, Metal Film, 34k ohm, ±1%, 1/8W	652-258
R4	Resistor, Carbon Film, 18k ohm, ±5%, 1/4W	650-123
R5	Resistor, Carbon Film, 3k ohm, ±5%, 1/4W	650-143
R6	Resistor, Metal Film, 2.2 ohm, ±1%, 2W	653-159
U1	I.C., 393 LIN Comparator, Dual	621-152

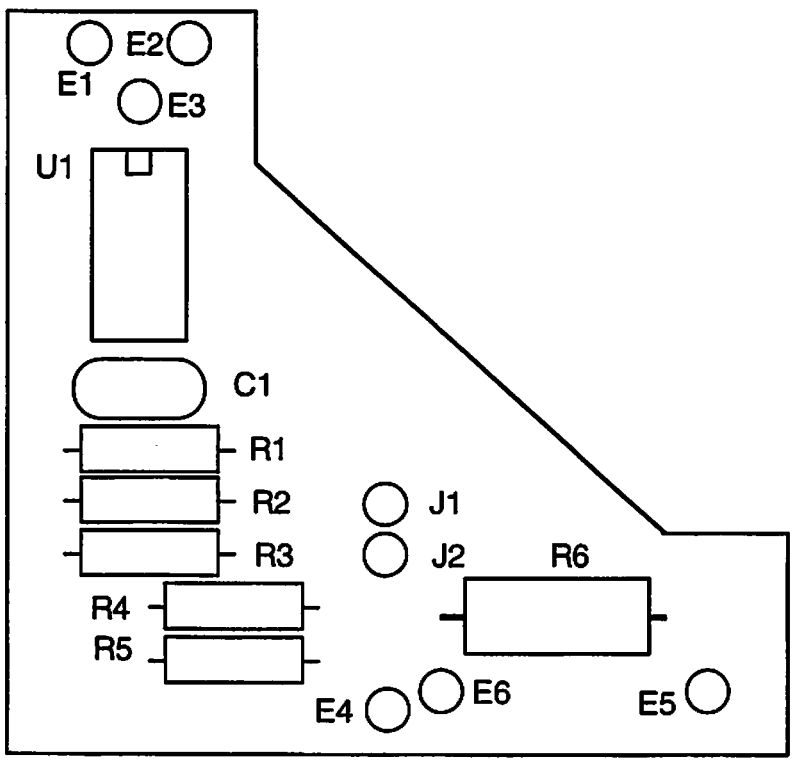


Figure 11-2. Battery Charger Control Circuit PWA 315-369

SECTION 12. TRANSFORMER ASSY 320-432

12.1 INTRODUCTION

This section contains component information about transformer assembly 320-432. This assembly is illustrated in FO-12A, Transformer Assembly 320-423.

12.2 PARTS LIST

(Refer to Foldout FO-12A)

ITEM	DESCRIPTION	PART NUMBER
1	TRANSFORMER, 100/120V PWR AC	668-136
3	RECEPTACLE, FASTON .110 X .020	734-167
4	CONTACT,CRIMP ON,0.045 IN	607-461
5	CONNECTOR,HOUSING,2 POSN	607-459
6	TUBING,SHRINKABLE 3/16ID CLEAR	742-122
7	VARISTOR 130VRMS 30 JOULES	628-113
8	CONN, 1CONT LINE SPLICE PIN	607-310
9	CONTACT, PIN .084 DIA 24-18 AWG	608-127
10	TYWRAP NYLON (NATURAL) 1.250	756-105

SECTION 13. TRANSFORMER ASSY 320-433

13.1 INTRODUCTION

This section contains component information about transformer assembly 320-433 and the variation listed below: This assembly is illustrated in FO-13A, Transformer Assembly 320-424.

13.2 PARTS LIST

(Refer to Foldout FO-13A)

ITEM	DESCRIPTION	PART NUMBER
1	TRANSFORMER, 230V PWR AC	668-135
2	FASTENER, NUT J TYPE NO.6 SCREW	716-133
3	RECEPTACLE, FASTON .110 X .020	734-167
4	CONTACT,CRIMP ON,0.045 IN	607-461
5	CONNECTOR,HOUSING,2 POSN	607-459
6	TUBING,SHRINKABLE 3/16ID CLEAR	742-122
7	VARISTOR 280VRMS 1W	628-114
8	CONN, 1CONT LINE SPLICE PIN	607-310
9	CONTACT, PIN .084 DIA 24-18 AWG	608-127
10	TYWRAP NYLON (NATURAL) 1.250	756-105
11	TUBING,SHRINK ADH LINED, BLK 1/4ID	742-402

SECTION 14. AC POWER CONN ASSY 320-431

14.1
INTRODUCTION

This section contains component information about AC power connector assembly 320-431.

14.2
PARTS LIST
(Refer to Foldout FO-14A)

ITEM	DESCRIPTION	PART NUMBER
1	MODULE, POWER ENTRY	624-113
2	CONN, 1CONT LINE SPLICE SOCKET	607-311
3	WIRE, 16AWG STRD PVC BLACK	680-221
4	WIRE,20AWG THICK PVC GRN/YEL	680-251
5	TUBING,SHRINKABLE 3/16ID CLEAR	742-122
6	TERMINAL LUG, BENT LCKNG, NO.6 HOLE	734-159
8	CONTACT SOCKET FOR 084DIA PIN	608-128

SECTION 15. PNEUMATICS PWA 315-317

15.1 INTRODUCTION

This section contains component information about the following pneumatics PWAs:

Version	Part Number
Older units	315-317
Newer units	315-316

Pneumatic hose connections are illustrated in Figure 15-1.

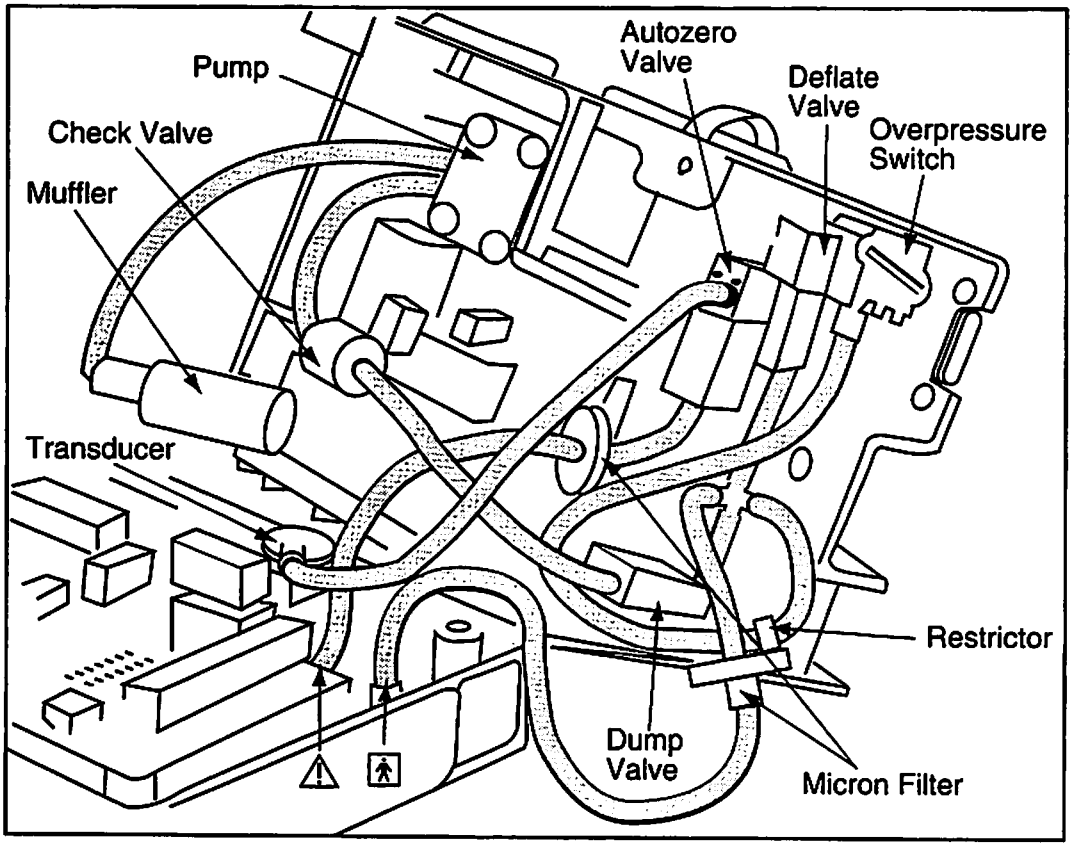


Figure 15-1. Pneumatics PWA Hose Connections

15.2 PRINCIPLES OF OPERATION

The pneumatic control circuits are shown on schematic SC315-317, located at the end of this section. Functionally, these circuits consist of the valve drive circuits, the pump drive circuits and the overpressure and safety interlocks.

15.2.1 Valve Drive Circuit

The valve solenoids are powered by the +8V supply and energized by digital control of VMOS FET switches Q1, Q3, Q4, and Q7.

AUTO ZERO valve MT1 is energized when Q3 is turned on by ZERO-1. When energized, the AUTO ZERO valve blocks the CUFF input port and connects the pressure transducer to atmosphere. When de-energized, the AUTO ZERO valve connects the pressure transducer to the CUFF input port.

DUMP valve MT3 is energized when Q4 is turned on by U2-10 or when Q7 is turned on by U3-10. U2-10 goes high when DUMP-0 is asserted or (U3-3) when the fail-safe alarm (FSALARM-0) or the overpressure signal (OP-1) is asserted. OP-1 also turns on Q7. When energized, the DUMP valve blocks the output of the air pump and ports the CUFF pressure port to atmosphere. When de-energized, the DUMP valve ports the output of the air pump to the CUFF pressure port.

DEFLATE valve MT2 is energized when Q1 is turned on by U2-4. This occurs when DEFLATE-0, FSALARM-0, and OP-1 are unasserted. When the DEFLATE valve is energized, the deflate line from the CUFF pressure port is blocked. When the DEFLATE valve is de-energized, the deflate line is ported to atmosphere through a restrictor in the DEFLATE valve common port tubing. The restrictor is built into the valve and no tubing is used. Zener diode D1 provides for a faster collapse of the solenoid fields of MT2 and MT3.

Resistors R25, R26, and R27 provide an average voltage reading, VLVSENSE, indicative of the current drain of all three solenoids which is used in manufacturing tests.

15.2.2 Pump Drive Circuit

Unregulated pump voltage Vp from the power supply is applied to the pump through Q2 and is regulated by U1. U1 is a pulse width modulator whose open-collector outputs drive the base of Q2. R-C circuitry R13 and C5 causes the modulator to operate at about 5 kHz. The outputs of the modulator are turned on and off by shutdown SD which is driven by U2-11. When PUMPON-1 is asserted, and DEFLATE-0, FSALARM-0, and OP-1 are not asserted, the modulator is turned on to provide a regulated 12 Vdc to the pump motor through Q2.

15.2.3 Overpressure Switch and Safety Interlocks

The overpressure switch is fed by a pneumatic line from the CUFF pressure port with a restrictor inline. The restrictor prevents pressure transients from falsely triggering the overpressure switch. The switch is set to trigger in the range of 265 mmHg to 355 mmHg.

The normally-open contacts of the overpressure switch (connected at J5 and J6) allow U3-12 to be pulled to ground through R6 which holds NOR latch U3 in the reset state. When an overpressure condition trips the switch, the contacts close and NOR latch U3 is set by +5 V through R20 to assert OP-1.

OP-1 enables U3-3 to energize DUMP valve MT3 and to de-energize DEFLATE valve MT2. This dumps cuff pressure and turns off the pump (U2-11). OP-1 also turns on Q7 which provides a back-up to energize the DUMP valve in the event Q4 fails. The CPU reads the OP-1 signal as a digital input bit to generate the 800 visual and audible alarm. When the overpressure switch closes, NOR latch U3 may be reset by PNEURESET-1 at U3-8. Capacitor C1 prevents a stuck PNEURESET-1 from holding the latch in the reset state. PNEURESET-1 is generated on the CPU PWA by the trailing edge of RESET-0 or by the leading edge of KEYCOL2 (CANCEL switch depression).

The fail-safe alarm interlocks are effected by U3-3 which disables U2 when the fail-safe alarm occurs (FSALARM-0). Thus, a fail-safe alarm will cause DUMP valve MT3 to energize, DEFLATE valve MT2 to de-energize and the pump drive circuit to be disabled. The output at U3-4 will also cause the audio annunciator circuit to generate the highest volume audio alarm.

15.3
PARTS LIST
(Refer to Foldout FO-15A)

ITEM	DESCRIPTION	PART NUMBER
AL1	BUZZER,SOLID STATE,3KHZ	600-114
C1,3,6, 16,18	CAP,CERAMIC,RAD,Z5U,50V,20%,0.1UF	602-107
C2,8,15,17	CAP,CERAMIC,RAD,Z5U,50V,20%,1.0UF	602-175
C4	CAPACITOR, 22UF, 50V ALUM ELECT	603-170
C5	CAP, POLY, RAD, 100V, 5%, 0.010 UF	603-109
C11	CAP,TANTALUM 2.2UF, 20V,10%	603-141
C12,C13	CAP,ELCTLT 10 UF 50V 20%	604-136
C14	CAP,CER 560PF 50V MIN10% AXIAL	602-155
CR1,3,5	DIO, SWITCHING 75V	610-104
CR2	DIO, RECT 1AMP 400V	610-103
D1	DIO, ZENER 7.5V, 5%, .5W	612-108
J1	RECPT 15 PIN RT.ANGLE BD.MOUNT	607-470
J2	CONN,HEADER,2 POSN,RT ANGLE	607-462
MT1,3	VALVE, ASSY 3-WAY 0.050 ORIFICE	616-130
MT2	VALVE, ASSY 3-WAY 0.030 ORIFICE	616-129
Q1,3,4,7	XSTR,VMOS FET	676-105
Q2	TRANSISTOR, PNP DARL PWR	673-108
Q5	XSTR, SW NPN	674-403
Q6	XSTR, SW PNP	674-404
R1,13,15,16	RES, CF 1/4 WATT, 5% 22K OHM	650-131
R2,3,9, 17,18	RES, CF 1/4 WATT, 5% 51K OHM	650-162
R4	RES, MF, 1/8 WATT, 1%, 16.2K OHM	652-225
R5	RES, CF 1/4 WATT, 5% 10K OHM	650-103
R6	RES, CF 1/4 WATT, 5% 5.1K OHM	650-161
R7	RES, CF 1/4 WATT, 5% 100K OHM	650-104

15.3
PARTS LIST
(CONT)
(Ref FO-15A)

ITEM	DESCRIPTION	PART NUMBER
R8,10,12	RES, MF, 1/8 WATT, 1%, 4.99K OHM	652-159
R11	RES, CF 1/4 WATT, 5% 1.2K OHM	650-111
R14,19	RES, CF 1/4 WATT, 5% 2K OHM	650-126
R20	RES, CF 1/4 WATT, 5% 560 OHM	650-199
R21	RES, CF 1/4 WATT, 5% 1K OHM	650-102
R22,23,24	RESISTOR, CF, 13 OHM, 5%, 1W	651-118
R25,26, R27	RES, MF, 1/8 WATT, 1%, 63.4K OHM	652-164
R28	RES, CF 1/4 WATT, 5% 470 OHM	650-156
U1	IC, 3524 REGULATOR PULSE WIDTH	621-215
U2	IC, CMOS 4 2-INPUT NAND	619-106
U3	IC, CMOS QUAD 2-INPUT NOR	619-105
U4	IC,MONOLITHIC VOLTAGE CONVERTR	621-202
#32	SWITCH, PRESSURE 300 MMHG	662-185
#33	TUBING PHARMED	¥ 740-185
	TUBING OD.250 ID.125	† 740-107
#34	CLAMP, HOSE 1/4 INCH	¥ 754-130
#36	FITTING, 'X' 1/8 INCH	754-117
#37	WASHER,.281 OD .116 ID .047THK	725-109
#38	WASHER,LOCK SPLIT #4 SST	724-101
#39	SCREW, 4-40X3/8 PHN PHH SST	719-110
#40	NUT,HEX #4 SST	715-107
#41	RESTRICTOR BARBED .012 ORIFICE	740-174
#46	TYWRAP NYLON (NATURAL) 2.0	756-405
#56	SPACER,RD NYL .250,.141,.562L	735-135
#57	TAPE,FOAM DBL ADHV 1/16X1.00	774-104
#58	FILTER, 43 MICRON DISP .AIRINLINE	754-118

¥ Used only on 315-316
† Used only on 315-317

SECTION 16. PNEUMATICS PWA 315-480

16.1 INTRODUCTION

This section contains component information about French pneumatics PWA 315-480 and overpressure PWA 315-409. Pneumatic hose connections are illustrated in Figure 16-1.

16.2 PRINCIPLES OF OPERATION

The pneumatic control circuits are shown on schematic diagrams SC315-434 (used for 315-480) and SC315-409, located at the end of this section. Functionally, these circuits consist of the valve drive circuits, the pump drive circuits and the overpressure and safety interlocks.

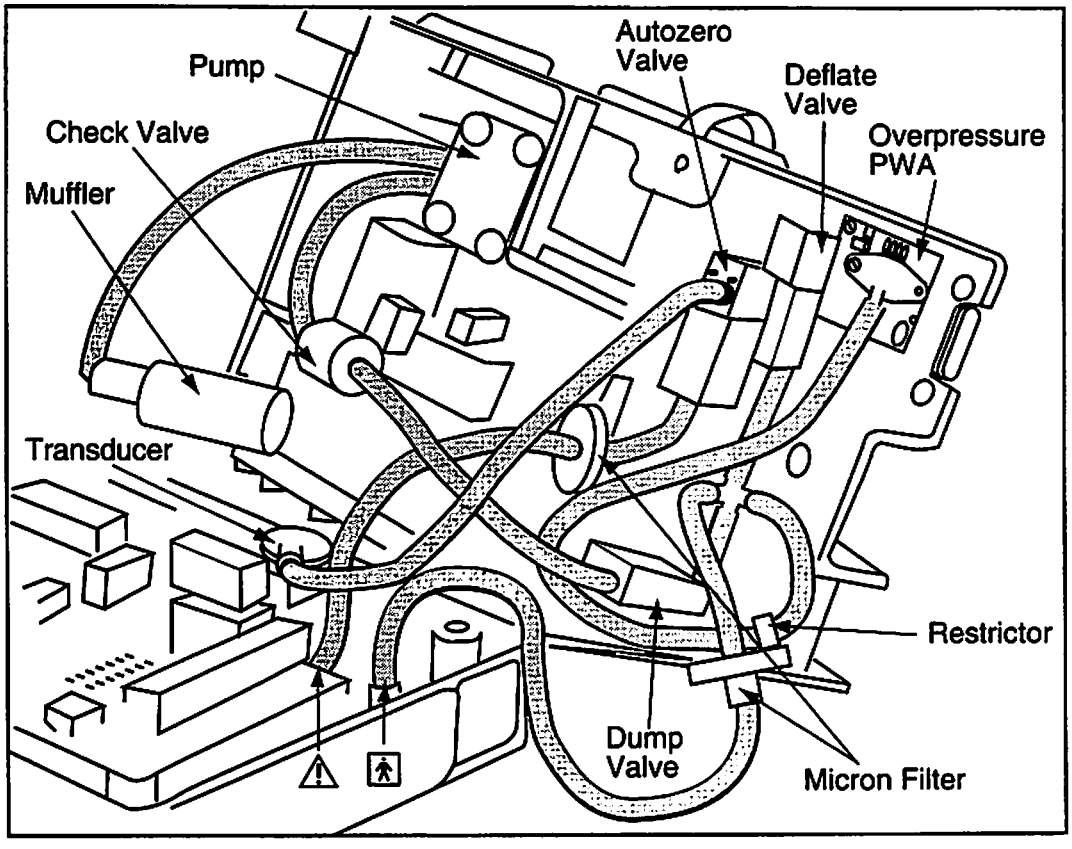


Figure 16-1. Pneumatics PWA 315-480 Hose Connections

16.2.1 Valve Drive Circuit

The valve solenoids are powered by the +8V supply and energized by digital control of VMOS FET switches Q1, Q3, Q4, and Q7.

AUTO ZERO valve MT1 is energized when Q3 is turned on by ZERO-1. When energized, the AUTO ZERO valve blocks the CUFF input port and connects the pressure transducer to atmosphere. When de-energized, the AUTO ZERO valve connects the pressure transducer to the CUFF input port.

DUMP valve MT3 is energized when Q4 is turned on by U2-10 or when Q7 is turned on by U3-10. U2-10 goes high when DUMP-0 is asserted or (U3-3) when the fail-safe alarm (FSALARM-0) or the overpressure signal (OP-1) is asserted. OP-1 also turns on Q7. When energized, the DUMP valve blocks the output of the air pump and ports the CUFF pressure port to atmosphere. When de-energized, the DUMP valve ports the output of the air pump to the CUFF pressure port.

DEFLATE valve MT2 is energized when Q1 is turned on by U2-4. This occurs when DEFLATE-0, FSALARM-0, and OP-1 are unasserted. When the DEFLATE valve is energized, the deflate line from the CUFF pressure port is blocked. When the DEFLATE valve is de-energized, the deflate line is ported to atmosphere through a restrictor in the DEFLATE valve common port tubing. The restrictor is built into the valve and no tubing is used. Zener diode D1 provides for a faster collapse of the solenoid fields of MT2 and MT3.

Resistors R25, R26, and R27 provide an average voltage reading, VLVSENSE, indicative of the current drain of all three solenoids which is used in manufacturing tests.

16.2.2 Pump Drive Circuit

Unregulated pump voltage Vp from the power supply is applied to the pump through Q2 and is regulated by U1. U1 is a pulse width modulator whose open-collector outputs drive the base of Q2. R-C circuitry R13 and C5 causes the modulator to operate at about 5 kHz. The outputs of the modulator are turned on and off by shutdown SD which is driven by U2-11. When PUMPON-1 is asserted, and DEFLATE-0, FSALARM-0, and OP-1 are not asserted, the modulator is turned on to provide a regulated 12 VDC to the pump motor through Q2.

16.2.3 Overpressure PWA

The overpressure PWA circuits are shown on schematic diagram SC315-409, located at the end of this section. This PWA is mounted on pneumatics PWA 315-480 as shown in Figure 16-2. The overpressure PWA is grounded at J1-2 by connection to the ground at C16 on the pneumatics PWA as shown on schematic diagram SC315-434. The overpressure PWA receives +8V power at J1-1 by connection to +8V at D1 on the pneumatics PWA. The ADULT-0/NEO-1 mode select signal from J6-1 on the system processor PWA is routed to the overpressure PWA at J1-3. Figure 16-2 shows these connections.

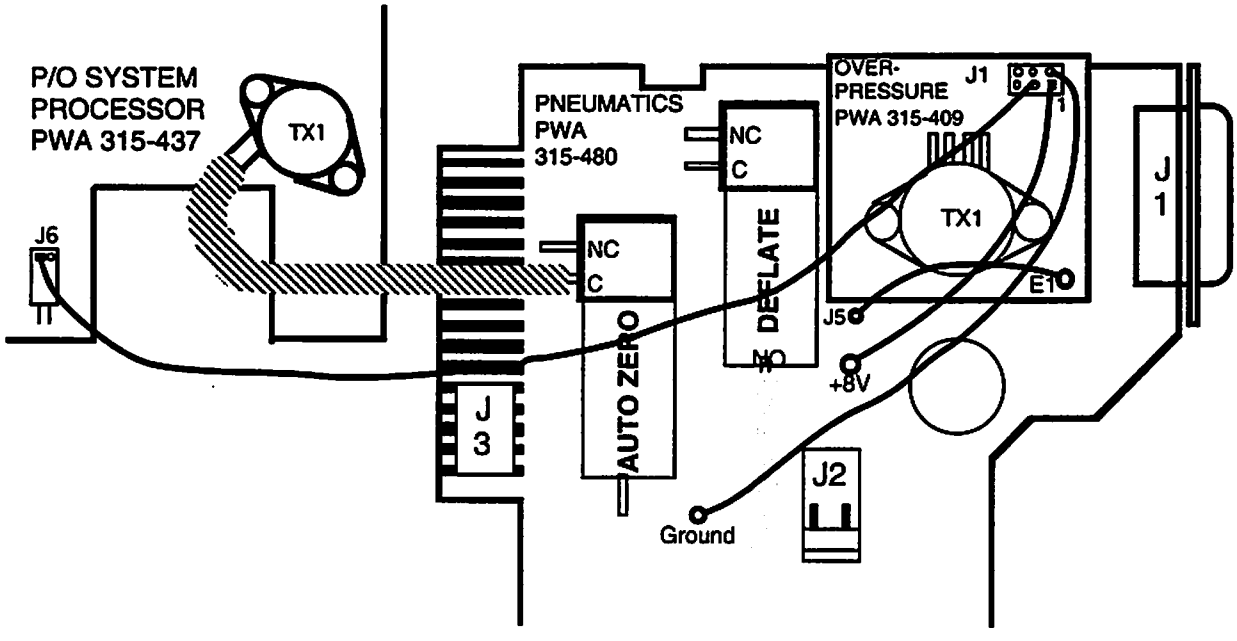


Figure 16-2. Overpressure PWA Connections

U1 on the overpressure PWA is a low power regulator which converts +8V to +5V regulated power for all active components. Pressure sensor TX1 senses pressure from pneumatic tubing connected to the CUFF pressure port. The sensor output is amplified by U2 and low pass filtered by R7 and C4 to prevent pressure transients from falsely triggering the overpressure condition.

The ADULT-0/NEO-1 mode select signal from the system processor determines the range setting of the overpressure switch. In neonate mode, the signal turns Q1 on, pulling the reference voltage at U3-5 down to the neonate trip point set by R12, R11, and R13. In adult mode, the neonate trip point is disabled when Q1 is off and the voltage at U3-5 floats to the +5V supply. The adult trip point is set by R5, R10, and R6 at U3-7. The outputs of the two comparator stages are wire OR'd. Overpressure signal OVP-0 from E1 is applied to pneumatics PWA J5-1 when the sensor signal level exceeds the selected preset limit.

16.2.4 Overpressure and Safety Interlocks

When an overpressure condition occurs, OVP-0 from the overpressure PWA pulls J5-1 high. This causes U3-11 to go low and produce overpressure signal OP-1. OP-1 enables U3-3 to energize DUMP valve MT3 and to de-energize DEFLATE valve MT2. This dumps cuff pressure and turns off the pump (U2-11). OP-1 also turns on Q7 which provides a back-up to energize the DUMP valve in the event Q4 fails. The system processor reads the OP-1 signal as a digital input bit to generate the 800 visual and audible alarm. During an overpressure condition, NOR latch U3 may be reset by PNEURESET-1 at U3-8. Capacitor C1 prevents a stuck PNEURESET-1 from holding the latch in the reset state. PNEURESET-1 is generated on the system processor PWA by the trailing edge of RESET-0 or by the leading edge of KEYCOL2 (CANCEL switch depression).

The fail-safe alarm interlocks are effected by U3-3 which disables U2 when the fail-safe alarm occurs (FSALARM-0). Thus, a fail-safe alarm will cause DUMP valve MT3 to energize, DEFLATE valve MT2 to de-energize and the pump drive circuit to be disabled. The output at U3-4 will also cause the audio annunciator circuit to generate the highest volume audio alarm.

16.3
PNEUMATICS PWA
315-480 PARTS LIST
(Refer to foldout FO-16A)

ITEM	DESCRIPTION	PART NUMBER
AL1	BUZZER,SOLID STATE,3KHZ	600-114
C1,3,6, 16,18	CAP,CERAMIC,RAD,Z5U,50V,20%,0.1UF	602-107
C2,8, 15,17	CAP,CERAMIC,RAD,Z5U,50V,20%,1.0UF	602-175
C4	CAPACITOR, 22UF, 50V ALUM ELECT	603-170
C5	CAP, POLY, RAD, 100V, 5%, 0.010 UF	603-109
C11	CAP,TANTALUM 2.2UF, 20V,10%	603-141
C12,13	CAP,ELCTLT 10 UF 50V 20%	604-136
C14	CAP,CER 560PF 50V MIN10% AXIAL	602-155
CR1,3,5	DIO, SWITCHING 75V	610-104
CR2	DIO, RECT 1AMP 400V	610-103
D1	DIO, ZENER 7.5V, 5%, .5W	612-108
J1	RECPT 15 PIN RT.ANGLE BD.MOUNT	607-470
J2	CONN,HEADER,2 POSN,RT ANGLE	607-462
MT1,3	VALVE, ASSY 3-WAY 0.050 ORIFICE	616-130
MT2	VALVE, ASSY 3-WAY 0.030 ORIFICE	616-129
Q1,3,4,7	XSTR,VMOS FET	676-105
Q2	TRANSISTOR, PNP DARL PWR	673-108
Q5	XSTR, SW NPN	674-403
Q6	XSTR, SW PNP	674-404
R1,13, 15,16	RES, CF 1/4 WATT, 5% 22K OHM	650-131
R2,3,9, 17,18	RES, CF 1/4 WATT, 5% 51K OHM	650-162
R4	RES, MF, 1/8 WATT, 1%, 16.2K OHM	652-225
R5	RES, CF 1/4 WATT, 5% 10K OHM	650-103
R6	RES, CF 1/4 WATT, 5% 5.1K OHM	650-161
R7	RES, CF 1/4 WATT, 5% 100K OHM	650-104
R8,10,12	RES, MF, 1/8 WATT, 1%, 4.99K OHM	652-159
R11	RES, CF 1/4 WATT, 5% 1.2K OHM	650-111
R14,19	RES, CF 1/4 WATT, 5% 2K OHM	650-126

16.3
PNEUMATICS PWA 315-480 PARTS LIST (CONT)

(Refer to foldout FO-16A)

ITEM	DESCRIPTION	PART NUMBER
R20	RES, CF 1/4 WATT, 5% 560 OHM	650-199
R21	RES, CF 1/4 WATT, 5% 1K OHM	650-102
R22,23,24	RESISTOR, CF, 13 OHM, 5%, 1W	651-118
R25,26,27	RES, MF, 1/8 WATT, 1%, 63.4K OHM	652-164
R28	RES, CF 1/4 WATT, 5% 470 OHM	650-156
U1	IC, 3524 REGULATOR PULSE WIDTH	621-215
U2	IC, CMOS 4 2-INPUT NAND	619-106
U3	IC, CMOS QUAD 2-INPUT NOR	619-105
U4	IC,MONOLITHIC VOLTAGE CONVERTR	621-202
	CABLE ASSY, EURO	316-540
	FILTER, 43 MICRON DISP .AIRINLINE	754-118
	FITTING, 'X' 1/8 INCH	754-117
	NUT, HEX, NYLON 4-40	716-147
	NUT,HEX #4 SST	715-107
	PWA, OVERPRESSURE SWITCH	*315-409
	RESTRICTOR BARBED .012 ORIFICE	740-174
	SCREW, 4-40X3/8 PHN PHH SST	719-110
	SCREW, NYLON, PANHEAD, 4-40 X 3/4	721-121
	SCREW,NYLON,PAN HEAD 4-40X1/2	721-107
	STANDOFF, 3/16 ROUND NYLON, FML 440	735-313
	TUBING PHARMED	740-185
	WASHER,.281 OD .116 ID .047THK	725-109
	WASHER,LOCK SPLIT #4 SST	724-101
	WIRE,26AWG,STRANDED,PVC, BLACK	680-254

*Refer to paragraph 16.4 for parts list.

16.4
OVERPRESSURE
PWA
PARTS LIST
(Refer to foldout FO-16B)

ITEM	DESCRIPTION	PART NUMBER
C1	CAP,CERAMIC,SMD,X75,50V,0.33 UF	605-239
C2,3,5	CAP,CERAMIC,SMD,X7R,50V MIN.,0.10 UF	605-233
C4	CAP,CERAMIC,SMD,X7R,50V,0.47 UF	605-241
J1	CONNECTOR, HEADER, DBL ROW .100 CTR	607-788
Q1	XSTR, N-CHAN MOS SOT-23	676-130
Q2	XST PNP SMT	674-126
R1	RES, SMD, 1/8 WATT,1%,19.6K,25PPM	654-616
R2	RESISTOR, SMD,1/8 WATT,1%,10.0K,25PPM	654-617
R3	RES,SMD,1/8 WATT,1%,715 OHM,25PPM	654-615
R4,9	RESISTOR, SMD, 1/8 WATT, 1%, 10.0K OHM	654-389
R5	RESISTOR, SMD, 1/8 WATT, 1%, 8.87K OHM	654-384
R6	RESISTOR, SMD, 1/8 WATT, 1%, 8.45K OHM	654-382
R7	RESISTOR, SMD, 1/8 WATT, 1%, 30.1K OHM	654-435
R8,15	RESISTOR, SMD, 1/8 WATT, 1%, 1.00M OHM	654-581
R10,11	POT, MULTI TURN, 1/4W, 10%, 10K	630-201
		or 630-199
R12	RESISTOR, SMD,1/8 WATT,1%,13.7K,25PPM	654-618
R13	RESISTOR, SMD,1/8 WATT,1%,8.45K,25PPM	654-619
R14	RESISTOR, SMD, 1/8 WATT, 1%, 1.00K OHM	654-293
R16	RESISTOR, SMD, 1/8 WATT, 1%, 100K OHM	654-485
U1	IC, 5V VOLTAGE REGULATOR SOIC	693-107
U2	IC, INSTR AMP, SETTABLE GAIN	691-129
U3	IC, QUAD COMPARATOR, PRECISION	691-128
U4	IC, DUAL OP-AMP, LM358AM	691-130
	NUT, HEX, NYLON 4-40	716-147
	SCREW,NYLON,PAN HEAD 4-40X1/2	721-107
	SENSOR, PRESSURE 0-375 MMHG	662-189